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EXPERIMENTAL HEAT-TRANSFER DISTRIBUTIONS ON A BLUNT LIFTING BODY AT MACH 3.71

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16. Abstract

The composite body consisted of a spherical nose segment, a delta-slab upper surface with blunt leading edges, wedge sides, and a conical lower surface. The tests were conducted both with and without roughness on the model for a range of angle of attack up to 40°. Included is a complete tabulation of the experimental heating rates and a discussion of the more significant findings.

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SUMMARY

Experimental heat-transfer distributions have been obtained on a composite lifting configuration which consisted of a spherical nose segment, a delta-slab upper surface with blunt leading edges, wedge sides, and a conical lower surface. The tests were conducted both with and without roughness on the model at Mach number 3.71, angles of attack up to 40°, and nominal unit Reynolds numbers of 3×10^{6}/ft (9.8×10^{6}/m) and 5×10^{6}/ft (16.3×10^{6}/m).

Heating distributions in the vertical plane of symmetry through the range of test variables were generally approximated by existing laminar or turbulent theories applied as if each component of the composite body was an isolated body. Heating distributions on the sides of the body through the range of test variables generally fall between flat plate and cone theories for either laminar or turbulent flow.

Transitional and turbulent flow occurred over most of the upper slab surface at positive angles of attack. Heating distributions obtained in this region for this condition were approximately the same either with or without roughness on the model.

INTRODUCTION

The geometry of lifting bodies generally includes various components similar in shape to simple cones, wedges, cylinders, spherical segments, and so forth. An approximate method for predicting the aerodynamic heating on these components consists of treating each component as an isolated body and using existing theories that are known to be applicable for that particular component. In order to determine the validity of this method for predicting the heating on lifting bodies made up of these components and also to determine the extent of the influence of the component parts on the heating distributions, experimental heat-transfer distributions were obtained on a composite body. The body geometry incorporated a blunted half-cone lower surface, wedge sides, and a blunt-slab upper surface.

The investigation was conducted in the Langley Unitary Plan wind tunnel at a Mach number of 3.71 and unit Reynolds numbers of 3×10^6/ft (9.8×10^6/m) and 5×10^6/ft (16.3×10^6/m). Tests were conducted both with and without roughness on the model. An angle-of-attack range from -30° to 40° and an angle-of-sideslip range from -10° to 10° were covered during the testing. The experimental heating data are compared with both laminar and turbulent theories. Pressure distributions on a similar body also tested in the Langley Unitary Plan wind tunnel have been reported in reference 1.

SYMBOLS

b	local skin thickness
c	specific heat of model skin
c_p	specific heat of air at constant pressure
h	heat-transfer coefficient
M	free-stream Mach number
N_{Re}	unit Reynolds number per foot (meter) based on free-stream conditions
N_{St}	Stanton number based on free-stream conditions
p_t	free-stream stagnation pressure
R	base radius of cone
s	distance along midline surface from thermocouple 1 (positive on top surface, negative on bottom surface) (see fig. 2)
T	temperature
T_e	measured wall temperature at steady-state conditions
T_t	stagnation temperature
T_w	wall temperature

t	time
V	free-stream velocity
x,y,z	rectangular Cartesian coordinates (see fig. 2)
α	angle of attack
β	angle of sideslip
ρ	density of model skin
ϕ	roll angle

Subscripts:

l	model length
0,1,2,. . . n	time sequence

APPARATUS AND TEST CONDITIONS

The investigation was conducted in the high Mach number test section of the Langley Unitary Plan wind tunnel described in reference 2. This variable-pressure, continuous-flow tunnel has an asymmetrical sliding-block nozzle that permits a continuous variation in the test-section Mach number from 2.30 to 4.65. The maximum deviation in Mach number over the 1.219- by 1.219-meter test section through the range of these tests was ±0.06. Heat-transfer measurements were obtained for the following test conditions.

Transition strip	Nominal N_{Re}		β, deg	α, deg (*)
	1/ft	1/m		
No	3×10^6	9.8×10^6	0	0, ±2, ±5, ±10, -15, 20, ±30, 40
No	3×10^6	9.8×10^6	±5, ±10	0, ±5, 10, -15, 20, ±30, 40
No	5×10^6	16.3×10^6	0	0, 10, 20
Yes	3×10^6	9.8×10^6	0	0, 5, 10, 15, 20, 30, 40
Yes	5×10^6	16.3×10^6	0	0, 20

*The negative values of α were obtained by rolling the model 180°.

MODEL AND INSTRUMENTATION

The model used in the investigation was a composite lifting configuration which consisted of a spherical nose segment, a delta-slab upper surface with blunt leading edges, wedge sides, and conical lower surface. Figure 1 presents an exploded view of the model to show the relationship of the component parts. The model was constructed of nominal 0.030-inch-thick (0.76 mm) Inconel-X sheet rolled and formed about a wooden mandrel and seam welded. The overall length of the model was 11.35 inches (283 mm) with base width of 6.60 inches (168 mm) and a base height of 5.69 inches (145 mm). Complete dimensions of the model are shown in figure 2.

Micarta bulkheads were stationed internally to support the sting, to provide strength and rigidity to the thin-walled model and to limit deflections in the model skin due to aerodynamic loads. Micarta was used as a bulkhead stiffener to reduce conduction losses from the model skin.

In an attempt to obtain turbulent heating rates, a limited number of tests were conducted with a transition strip on the model. The strip consisted of No. 35 carborundum grit in a band approximately 1/4 inch (6.35 mm) wide and was located on the model as illustrated in figure 2(b).

The model was instrumented with eighty-one 30-gage iron-constantan thermocouples on one-half of the model and on the base (relative to the vertical plane of symmetry). The location of the instrumentation is shown in figure 2(b) and a complete list of instrumentation coordinates is given in table I.

The thermocouple outputs were amplified, digitized, and magnetically recorded by a high-speed analog-digital recording system. Although this system can obtain up to 40 samples a second, the outputs for this test were recorded only every 1/2 second.

The tunnel free-stream static and stagnation pressures were measured on precision mercury manometers. The test-section stagnation temperature was measured with probes attached to the vertical wall of the test section external to the side-wall boundary layer and located at the same longitudinal location as the model.

METHOD OF HEAT-TRANSFER DATA REDUCTION

The heat-transfer coefficients were obtained from transient skin-temperature measurements resulting from a stepwise increase in stagnation temperature. This technique is described in detail in reference 3.

The heat-balance equation reduces to the following equation when it is assumed there is negligible lateral heat flow, constant temperature through the model skin,

negligible heat flow to the model interior, and no heat losses due to radiation:

$$h = \frac{\rho bc \frac{dT_w}{dt}}{T_e - T_w} \tag{1}$$

This equation can be integrated and written in the following form for complete machine calculation:

$$h = \frac{\rho bc(T_{w,n} - T_{w,0})}{\frac{T_e}{T_t}\int T_t \, dt - \int T_w \, dt} \tag{2}$$

The heat-transfer coefficients were converted to Stanton numbers from the following equation:

$$N_{St} = \frac{h}{\rho V c_p} \tag{3}$$

Equation (2) was used for determining the heat-transfer coefficients of this investigation. The integrals were evaluated at time increments of 0.5 second according to the trapezoidal rule which yields

$$\int_0^n T \, dt = \Delta t\left(\frac{1}{2} T_0 + \frac{1}{2} T_n + T_1 + T_2 \ . \ . \ . + T_{n-1}\right) \tag{4}$$

and the ratio of T_e/T_t was experimentally determined.

ACCURACY

The accuracy of the temperature measurements, including recorder resolution, thermocouple-wire calibration, and cold-junction temperature, is $\pm 1.0^{\circ}$ K; however, this error occurs in temperature level rather than in random temperature fluctuations. Also, as mentioned in reference 4, in regions of low heat transfer such as the model base, the ratio T_e/T_t may be questionable because the wall temperature may not have reached equilibrium from the preceding test point.

The effect of the lateral heat flow on the values of h was approximated at several locations, and with the exception of the spherical segment nose, this effect was found to be well within the data accuracy. For the spherical segment nose, however, these estimations indicated errors as large as 25 percent.

An estimation of the repeatability of heat-transfer measurements in the Langley Unitary Plan wind tunnel has been determined by the repeatability of data in the tests discussed in reference 4. It is believed these repeatabilities would also apply to this investigation with the exception of the spherical segment nose. The repeatability of the measurements as discussed in reference 4 is dependent on the magnitude of the heat-transfer coefficient. For $h > 0.015 \frac{\text{Btu}}{\text{ft}^2\text{-sec-}^{\circ}\text{R}}$ (306 $J/m^2\text{-sec-}^{\circ}K$), the repeatability is within 10 percent; for $0.001 < h < 0.015 \frac{\text{Btu}}{\text{ft}^2\text{-sec-}^{\circ}\text{R}}$ ($20 < h < 306$ $J/m^2\text{-sec-}^{\circ}K$), within 15 percent; and for $h < 0.001 \frac{\text{Btu}}{\text{ft}^2\text{-sec-}^{\circ}\text{R}}$ (20 $J/m^2\text{-sec-}^{\circ}K$), within 20 percent. Although $h < 0.001 \frac{\text{Btu}}{\text{ft}^2\text{-sec-}^{\circ}\text{R}}$ (20 $J/m^2\text{-sec-}^{\circ}K$) is within the accuracy of data reduction, no significance is attached to the magnitude of h, other than to indicate regions of low heat transfer. The accuracy of the precision manometers is within 0.5 lb/ft^2 (23.94 N/m^2).

RESULTS AND DISCUSSION

Heating in Vertical Plane of Symmetry

Experiment.- Complete tabulations of the experimental results are presented in tables II to V. Throughout the "Results and Discussion," the terminology describing the various components of the model is the same as that shown in figure 1. Measured surface heating distributions in the vertical plane of symmetry are presented in figure 3 through the test range of angle of attack. The negative angles of attack were obtained by rolling the model 180° as mentioned previously. With the exception of $\alpha = -30^{\circ}$, the heating rates on the half-cone surface ($s/R < 0.98$) increase with increasing angle of attack as would be expected. At $\alpha = -30^{\circ}$, a large increase in heating occurs at the last two instrumented stations. This increase in heating is believed to be a result of boundary-layer transition promoted by the increase in vorticity associated with this surface becoming leeward to the free-stream flow for $\alpha < -15^{\circ}$. (As shown in fig. 2(a), the half-cone angle is 15°.)

For angles of attack from -10° to 40°, the heating rates on the conical nose are relatively insensitive to angle of attack as shown in figure 3. From laminar tangent swept cylinder theory (to be discussed subsequently), the laminar stagnation-line heating of the conical nose should decrease by approximately 25 percent and this decrease is roughly the variation shown. For an angle of attack of -30°, the conical-nose stagnation-line heating rates at the larger values of s/R are significantly less than those obtained at the other angles of attack.

Heating distributions obtained on the flat top surface, $s/R > 0.2$, as shown in figure 3 are believed to be strongly influenced by boundary-layer transition promoted by the large amount of vorticity present even at $\alpha = 0^{o}$. (See ref. 1.) The location of transition (as indicated by the increase in heating) at $\alpha = 0^{o}$ is apparently located downstream of the thermocouple location $s/R = 0.68$. With increasing angle of attack, transition moves upstream; at $\alpha = 20^{o}$, a turbulent boundary layer exists over most of the flat top surface in the vicinity of its center line. On the other hand, for $\alpha = -30^{o}$ (flat top surface windward), a laminar boundary layer exists over most of the flat top surface. These deductions pertaining to the location of boundary-layer transition will be further substantiated subsequently when these data are compared with measurements obtained with a transition strip installed on the model and with theoretical distributions.

The effects of angle of sideslip on the center-line heating distributions are shown in figure 4 for angles of attack of -30^{o}, 0^{o}, 20^{o}, and 40^{o}. The results are presented for $\beta = 0^{o}$, and $\pm 10^{o}$; throughout the test range of variables, the heating rates for these two sideslip angles are essentially the same as would be expected. This comparison gives a good indication of data repeatability. In general, changing the sideslip angle from 0^{o} to $\pm 10^{o}$ results in only slight variations in the magnitude of the heating rates along the vertical plane of symmetry for those regions not influenced by boundary-layer transition.

Heating distributions in the vertical plane of symmetry both with and without roughness on the model are shown in figure 5. The locations of the roughness elements as described previously are shown in figure 2(b). Through the range of angle of attack from 0^{o} to 40^{o}, the experimental data for the model with roughness is believed to be representative of a fully developed turbulent boundary layer over the half-cone and flat top surfaces. This deduction is based on a comparison of the magnitude and distribution of the heating rates with and without roughness as well as comparisons between experiment and theory to be discussed subsequently. A comparison of the heating rates obtained on the flat top surface with and without roughness for $\alpha = 20^{o}$ and $\alpha = 40^{o}$ indicates that within this region, the boundary layer was fully turbulent even without roughness. A slight increase in heating occurred on the conical nose with roughness on the model; however, whether this increase is associated with boundary-layer transition is not known.

Heating distributions obtained in the vertical plane of symmetry at Reynolds number per meter of approximately 9.8×10^{6} and 16×10^{6} are presented in figure 6 both with and without roughness on the model. The data are presented in the form of the laminar correlation parameter $N_{St}\sqrt{N_{Re,l}}$ for the clean model (fig. 6) and in the form of the turbulent correlation parameter $N_{St}(N_{Re,l})^{1/5}$ for the model with roughness (fig. 6(b)). The heating distributions on the flat top surface both with and without roughness indicate a slight forward movement of the location of transition with the indicated increase in Reynolds number.

Theoretical approximations.- Since the lifting entry configuration for this investigation was formed from a combination of such basic shapes as cones, cylinders, wedges, and so forth, it was decided to explore fully the applicability of approximate theories to the composite body that are known to apply to the individual basic components. The approximate theories used are both laminar and turbulent cone and flat-plate theories, tangent swept-cylinder theory, and cross-flow theory.

Theoretical distributions for the half-cone surface are shown in figure 7 for the test range of angle of attack. Results for positive angles of attack (half-cone windward) are presented in figure 7(a) for both laminar and turbulent flow for comparison with the experimental data with and without roughness, respectively. The theoretical distributions consist of flat-plate and cone theories (ref. 5) and swept-cylinder theory (ref. 6). The distributions shown for the flat-plate and cone theories are based on measured surface pressures from reference 1, a local total pressure corresponding to free-stream pitot pressure, and the virtual origin of the boundary layer located at thermocouple 8 $\left(\frac{s}{R} = -0.89\right)$. The tangent-swept-cylinder theories assume that the local heating along the half-cone stagnation line for $\alpha > 0^{\circ}$ is approximated by the heating on a tangent swept cylinder having a diameter equal to the local cone diameter.

As shown in figure 7(a), the laminar and turbulent cone theories for $\alpha = 0^{\circ}$ are in good agreement with the measured heating distributions on the half cone for the clean model and model with roughness, respectively. Although not shown in figure 7(a), the cone theory for $\alpha > 0^{\circ}$ underpredicts the magnitude of the measured heating rates, the extent of this disagreement increasing with increasing angle of attack. The tangent swept cylinder approximations, however, are generally in good agreement with the experimental results for $10 \leqq \alpha \leqq 40^{\circ}$ with either a laminar or turbulent boundary layer. For the negative angles of attack (half-cone leeward) (fig. 7(b)), the laminar flat-plate theory best approximates the measured laminar heating rates.

Theoretical and experimental heating distributions for the top flat surface are shown in figure 8. For positive angles of attack (top flat surface leeward) (fig. 8(a)) flat-plate theories are shown for both laminar and turbulent flow for comparison with the experimental results obtained on the clean model and model with roughness, respectively. The theoretical distributions were determined from the flat-plate theory of reference 5 and by assuming that the virtual origin of the boundary layer occurred at $s/R = 0$. A theoretical laminar distribution was only determined for $\alpha = 0^{\circ}$ since, as discussed previously, the boundary layer in this region was turbulent for positive angles of attack. Even at $\alpha = 0^{\circ}$, a large portion of the top flat surface is affected by transitional flow; thus, poor agreement with the laminar theoretical distributions results. The turbulent theoretical distributions are in good agreement with the experimental results for the

model with roughness at $\alpha = 20^{\circ}$ and $\alpha = 40^{\circ}$. At $\alpha = 0^{\circ}$, however, the turbulent theoretical distributions are approximately 25 percent greater than the experimental results.

Theoretical and experimental heating distributions for the top flat surface at negative angles of attack (flat surface windward) are shown in figure 8(b). The theoretical distributions consist of laminar flat-plate theory, the cross-flow theory of reference 7, and a modified laminar tangent cylinder approximation. The flat-plate theory was determined in the same manner as discussed in the preceding paragraph. The modified laminar tangent cylinder approximation consists of applying swept cylinder theory to each location along the center line based on a diameter equal to the local span. The stagnation-line velocity gradient was assumed to correspond to that at the stagnation point of a body of revolution having a cross section similar to the cross section of the flat top perpendicular to the center line and including the cylindrical-segment leading edges. The local velocity gradients were determined from the experimental results of reference 8. In a plane perpendicular to the center line of the flat top surface, the cylindrical leading edges are actually elliptic; however, since the leading-edge sweep is large (75°), this effect on the stagnation-line velocity gradient is negligible. The stagnation-point velocity gradient for a body of revolution is believed to be a good approximation for the stagnation-line velocity-gradient on a two-dimensional body of the same cross section. This approximation is validated to some extent by experimental velocity distributions on spheres and cylinders shown in reference 7, and also by Newtonian theory which predicts the local velocity gradient as a function of only one geometry variable, the local surface slope relative to the free-stream velocity vector. The modified tangent cylinder approximation is very similar to the cross-flow theory of reference 7, the major exception being that the stagnation-line heating is assumed to be two dimensional for the present approximation rather than three dimensional.

In general, poor agreement is shown in figure 8(b) between experiment and the laminar flat-plate theories for the negative angles of attack (flat surface windward). At $\alpha = 0^{\circ}$, transition affects a large region of the flat-top surface and therefore such disagreement would be expected. For $\alpha = -10^{\circ}$, however, it is believed that transition only affects the last instrumented station and upstream of this station better agreement with theory was anticipated. The measured heating rates are less than the theoretical values; this same trend is noted at $\alpha = 0^{\circ}$ for turbulent flow as shown in figure 8(a).

The laminar flat-plate theory values for $\alpha = -30^{\circ}$ (fig. 8(b)) are less than the experimental values as would be expected. A comparison of these measured values with turbulent flat-plate theory (not shown in figure) indicates that the boundary layer over the flat top surface was laminar. The modified tangent cylinder approximation is in good agreement with the experimental values at $\alpha = 20^{\circ}$ whereas the cross-flow theory of

reference 7 overpredicts these values. A possible explanation for this disagreement is that the sweep angle of the present configuration (75°) is greater than the sweep of the models for which the results are presented in reference 7.

Theoretical tangent swept cylinder heating distributions along the conical nose stagnation line are shown in figure 9 for both laminar and turbulent flow. For positive angles of attack (fig. 9(a)), laminar theoretical distributions are in fair agreement with the experimental data on the clean model for $s/R < -0.32$ or for values of s/R less than approximately one spherical nose diameter. For $s/R > -0.32$, the experimental data are greater than the theoretical distributions because of the spherical-segment nose effect. No significance is placed on the absolute magnitude of the heating rates on the spherical-segment nose because of the large conduction errors that are known to be present.

Since only small changes in the magnitude of the experimental heating rates on the conical-nose stagnation line occurred when roughness was placed on the model, the laminar theoretical distributions are also shown in figure 9(a) for the model with roughness. For $\alpha = 0^{\circ}$, the experimental heating rates fall between the laminar and turbulent theoretical heating distributions. This is the same trend noted in reference 5 for swept cylinders at small angles of sweep. At $\alpha = 30^{\circ}$, the stagnation line of the conical nose is perpendicular to the free-stream velocity vector corresponding to a sweep angle of 90°. For this condition, the turbulent swept cylinder theory predicts zero heat transfer; however, as noted in reference 5, this prediction is not physically realistic since a laminar boundary layer would always exist for these conditions with no possible mechanism present to cause a turbulent boundary layer. The experimental data for $s/R < -0.5$ at $\alpha = 30^{\circ}$ are very similar to the results shown for the clean model at this angle of attack and are in fair agreement with the laminar theory.

Theoretical laminar heating distributions for the conical nose at negative angles of attack are shown in figure 9(b). Similar to the trends noted at positive angles of attack, the theoretical and experimental data are in good agreement for values of s/R less than approximately one nose diameter through $\alpha = -30^{\circ}$.

Heating on Wedge Sides

Measured heating distributions obtained on the wedge sides are shown in figure 10 for angles of attack from -30° to 40°. The heating rates are presented as a function of $\Delta x/R$ where Δx is the axial length from the point of tangency of the conical nose and wedge side for each value of z/R. Laminar strip theory distributions for conical and two-dimensional flow are also shown for each angle of attack and are based on measured pressures from reference 1. Since there was no continuous row of pressure instrumentation on the wedge surface, the data at $z/R = 0.3$ and $z/R = 0.37$ were used. For $\alpha = -30^{\circ}$, a laminar swept-cylinder theoretical value (ref. 5) is shown for comparison with

the data obtained at $z/R = 0.120$. The stagnation line on a 15^{o} swept delta wing with cylindrical leading edges at $\alpha = 30^{o}$ should be located on the leading edges approximately 65^{o} below the stagnation line at $\alpha = 0^{o}$. If the stagnation line of the present configuration at $\alpha = -30^{o}$ is also on the cylindrical leading edges and located at the same location as the analogous delta-wing configuration, it would then be located 65^{o} from the point of tangency of the wedge sides and the cylindrical leading edges ($z/R = 0.12$). It was for these conditions that the theoretical swept cylinder value was evaluated. The experimental data downstream of the spehrical-segment nose effects are in good agreement with this calculated value. Since the stagnation line is apparently located on the cylindrical leading edge for this angle of attack, the resulting cross flow would be expected to produce heating gradients in the z direction on the wedge sides as is indicated by the experimental results shown in figure 10(a). With increasing angle of attack to -10^{o} (fig.10(b)), the heating rates at $z/R = 0.120$ should increase if the stagnation line remains on the cylindrical leading edge since it would approach this z/R position. The data decreases, however, and indicate that a stagnation line no longer exists on the cylindrical leading edge. The experimental results for $z/R > 0.120$ and upstream of the effect of transition tend to fall within a narrow band the magnitude of which is approximated by the laminar flat-plate theory. Similar trends in the measured heating are shown in figure 10(c) for $\alpha = 0^{o}$; however, the magnitude of these heating rates tend to approach the cone theory. With further increases in angle of attack (fig. 10(d) and 10(e)), all the data including that at $z/R = 0.12$ fall within a relatively narrow band. The magnitude of this band of data for laminar flow tends to approach the flat-plate theory with increasing angle of attack through $\alpha = 40^{o}$.

Experimental and theoretical heating distributions for the wedge sides are shown in figure 11 for angles of sideslip of $\pm 10^{o}$ at $\alpha = 0^{o}$. For $\beta = 10^{o}$ (instrumentation windward), an increase in heating relative to the $\beta = 0^{o}$ results occurs as would be expected. The magnitude of these heating rates for $\Delta x/R < 0.75$ fall between the flat-plate and cone theories; however, for larger values of $\Delta x/R$, good agreement is obtained with the cone theory. With decreasing angle of sideslip to -10^{o} (fig. 11(b)), a decrease in heating occurs and the magnitudes of the heating rates at this sideslip angle are roughly approximated by the flat-plate theory.

Heating distributions on the wedge side for the model with roughness are shown in figure 12 for angles of attack from 0^{o} to 40^{o}. At $\alpha = 0^{o}$ (fig. 12(a)), the location of transition is considerably forward of the location indicated by the heating rates on the clean model at $\alpha = 0^{o}$ (fig. 10(a)), and for values of $\Delta x/R > 1$ the magnitudes of the heating rates fall within a narrow band bounded by the turbulent flat-plate and cone theories. For $\alpha = 20^{o}$ and $\alpha = 40^{o}$, the location of transition for most values of z/R is not significantly different from that indicated by the experimental data on the clean model.

The magnitude of the maximum heating rates at $z/R = 0.37$ for these angles of attack as shown in figure 12 also falls between the two theoretical distributions similar to the results shown at $\alpha = 0^{\circ}$.

SUMMARY OF RESULTS

Experimental heat-transfer distributions have been obtained on a composite lifting configuration which consisted of a spherical nose segment, a delta-slab upper surface with blunt leading edges, wedge sides, and a conical lower surface. The tests were conducted both with and without roughness on the model at Mach number 3.71, angles of attack up to 40°, and nominal unit Reynolds numbers of 3×10^6/ft $(9.8 \times 10^6/\text{m})$ and 5×10^6/ft $(16.3 \times 10^6/\text{m})$. The results are summarized as follows:

1. Heating distributions in the vertical plane of symmetry through the range of test variables were generally approximated by existing laminar or turbulent theories applied as if each component of the composite body was an isolated body.

2. Heating distributions on the sides of the body through the range of test variables generally fell between flat-plate and cone strip theories for either laminar or turbulent flow.

3. Transitional and turbulent flow occurred over most of the flat top surface at positive angles of attack. Heating distributions obtained in this region for this condition were approximately the same either with or without roughness on the model.

Langley Research Center,
National Aeronautics and Space Administration,
Langley Station, Hampton, Va., October 1, 1969.

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TABLE I.- THERMOCOUPLE LOCATIONS

Thermocouple	Location	s/R	z/R	x/R
1	Midline - nose	0.000	0.120	0.092
2		-.082	.210	.140
3		-.200	.300	.190
4		-.320	.400	.250
5		-.450	.520	.320
6		-.610	.650	.390
7		-.800	.850	.490
8	Midline - lower surface	-.890	.920	.560
9		-.990	.970	.650
10		-1.710	1.150	1.350
11		-2.500	1.360	2.100
12		-3.280	1.560	2.860
13	Midline - upper surface	.098	.037	.130
14		.200	.000	.220
15		.350	.000	.380
16		.690	.000	.710
17		1.320	.000	1.350
18		2.080	.000	2.100
19		2.840	.000	2.860
20	Top surface		.000	.710
21			.000	1.350
22			.000	2.100
23			.000	2.860
24	Spherical segment		.064	.153
25	Cylindrical edge		.037	.220
26			.037	.380
27			.037	.710
28			.037	1.350
29			.037	2.100
30			.037	2.860
31	Conical nose		.120	.120
32	Wedge side		.120	.220
33			.120	.380
34			.120	.560
35			.120	.710
36			.120	.920
37	Conical nose		.207	.147
38	Wedge side		.210	.277
39			.210	.380
40			.210	.560
41			.210	.710
42			.210	.920
43	Conical nose		.260	.200
44	Wedge side		.300	.380
45			.300	.560
46			.300	.710
47			.300	.920
48	Conical nose		.370	.270
49	Wedge side		.370	1.350
50			.370	2.100
51			.370	2.860
52			.400	.440
53			.400	.560
54			.400	.710
55			.400	.920
56	Conical nose		.480	.345
57	Wedge side		.520	.530
58			.520	.710
59			.520	.920
60	Conical nose		.610	.420
61	Wedge side		.720	.710
62			.720	.920
63			.720	1.350
64			.720	2.100
65			.720	2.860
66	Conical nose		.820	.560
67	Spherical segment		.870	.500
68	Conical lower surface		.900	.610
69			1.030	1.350
70			1.170	2.100
71			1.310	2.860

TABLE II.- TABULATION OF HEAT-TRANSFER MEASUREMENTS ON CLEAN MODEL AT A NOMINAL REYNOLDS NUMBER BASED ON MODEL LENGTH OF 3.0×10^6

(a) $\alpha = -30^\circ$

Thermocouple	$\beta = -10^\circ$; $T_w = 391^\circ$ K; $p_t = 278.9$ kN/m^2				$\beta = -5^\circ$; $T_w = 391^\circ$ K; $p_t = 278.9$ kN/m^2				$\beta = 0^\circ$; $T_w = 390^\circ$ K; $p_t = 279.4$ kN/m^2			
	$\frac{T_e}{T_t}$	T_w, °K	h (a)	N_{St}	$\frac{T_e}{T_t}$	T_w, °K	h (a)	N_{St}	$\frac{T_e}{T_t}$	T_w, °K	h (a)	N_{St}
1	.97462	367.3	521.9	.007338	.97523	375.4	515.5	.007255	.97680	372.5	461.1	.006468
2	.95640	351.2	373.6	.005252	.95604	350.4	380.5	.005355	.95723	358.1	356.5	.005000
3	.95025	341.4	264.1	.003713	.95027	340.6	265.4	.003735	.95185	344.6	253.8	.003559
4	.94793	336.0	207.3	.002914	.94832	335.3	207.3	.002917	.95006	339.0	198.1	.002779
5	.94590	332.3	176.2	.002477	.94682	331.9	175.8	.002475	.94864	335.4	168.2	.002360
6	.94560	331.6	162.0	.002278	.94742	331.6	162.4	.002285	.94946	335.3	156.1	.002190
7	.93204	326.1	159.5	.002243	.93416	326.4	161.2	.002268	.93654	330.1	153.1	.002147
8	.90797	310.9	115.4	.001623	.90995	311.0	114.7	.001615	.91181	314.5	112.3	.001575
9	.89620	299.6	55.9	.000785	.89818	297.7	52.2	.000735	.90016	300.6	58.0	.000813
10	.91817	298.2	10.1	.000142	.92561	301.9	16.0	.000225	.93041	305.9	20.2	.000283
11	.91667	298.8	17.2	.000242	.90530	299.3	37.6	.000529	.90614	303.0	45.9	.000643
12	.91142	297.8	21.4	.000300	.89975	298.0	41.2	.000580	.90457	303.8	53.0	.000743
13	.97931	371.1	583.0	.008197	.98039	371.0	597.0	.008402	.98262	376.3	468.7	.006574
14	.96360	357.7	392.6	.005519	.96399	357.3	404.7	.005696	.96634	364.7	369.6	.005184
15	.95543	339.7	215.3	.003027	.95619	339.1	214.4	.003018	.95813	343.5	210.1	.002946
16	.95318	328.8	119.3	.001677	.95409	327.3	111.8	.001574	.95618	331.1	111.9	.001569
17	.95048	323.3	88.5	.001245	.95439	322.5	78.2	.001101	.95686	324.7	71.7	.001005
18	.95655	324.9	63.5	.000893	.95439	320.5	62.0	.000873	.95857	322.7	52.5	.000737
19	.95145	343.8	244.8	.003441	.95402	319.6	52.6	.000740	.95723	321.0	44.3	.000622
20	.94913	328.5	142.1	.001998	.95230	330.6	154.2	.002170	.95611	337.5	168.7	.002367
21	.94815	325.0	107.6	.001513	.94750	326.0	121.4	.001708	.94677	332.4	147.2	.002064
22	.94860	324.6	90.9	.001278	.94210	322.0	106.8	.001503	.94050	328.0	133.9	.001878
23	.93661	327.3	140.2	.001971	.93775	320.6	105.0	.001478	.93796	326.0	124.4	.001745
24	.96172	356.6	399.2	.005612	.96571	368.8	421.5	.005933	.97142	368.0	409.4	.005742
25	.95228	346.9	329.8	.004637	.95634	349.4	361.1	.005082	.96216	356.1	371.2	.005206
26	.94231	331.9	194.5	.002734	.94750	336.1	222.7	.003135	.95476	344.5	237.7	.003333
27	.93526	324.1	134.6	.001893	.94255	330.2	167.2	.002353	.94939	339.1	189.1	.002652
28	.93219	320.4	108.3	.001523	.93468	334.9	135.1	.001916	.93758	333.0	166.6	.002336
29	.92791	318.1	96.6	.001358	.92749	329.0	117.2	.001649	.93355	329.4	158.4	.002222
30	.91547	316.9	130.1	.001829	.92269	326.3	114.9	.001617	.93004	330.2	147.2	.002065
31	.95910	355.8	394.8	.005550	.96324	368.1	418.2	.005886	.96888	367.4	410.7	.005760
32	.93781	331.7	215.9	.003036	.94285	335.6	244.3	.003438	.95006	344.4	260.4	.003653
33	.93016	318.6	124.2	.001747	.93611	323.3	147.8	.002080	.94393	332.5	170.2	.002387
34	.92679	315.2	100.7	.001415	.93423	321.2	128.1	.001803	.94259	330.8	151.0	.002118
35	.92221	312.9	95.3	.001339	.92981	319.5	126.1	.001775	.93848	329.4	150.2	.002107
36	.92064	311.3	88.0	.001238	.92876	318.1	118.6	.001669	.93631	327.4	144.6	.002028
37	.94126	340.4	289.4	.004069	.94525	343.3	319.7	.004500	.95170	350.8	321.6	.004511
38	.92904	315.6	111.2	.001563	.93423	324.2	135.5	.001907	.94169	328.3	160.2	.002247
39	.92686	310.7	75.9	.001068	.93273	318.6	97.0	.001366	.94035	323.1	120.5	.001690
40	.92386	308.3	64.6	.000908	.93018	313.3	88.3	.001243	.93841	322.2	110.6	.001551
41	.92289	307.1	57.0	.000801	.92936	312.6	84.5	.001189	.93751	321.4	107.0	.001500
42	.92109	306.1	55.7	.000783	.92794	312.0	82.4	.001160	.93549	320.6	105.6	.001481
43	.93451	327.7	187.0	.002629	.93880	331.0	208.7	.002937	.94573	339.0	221.8	.003111
44	.92739	310.0	66.6	.000937	.93318	317.2	84.7	.001192	.94057	321.4	104.8	.001469
45	.92611	306.3	40.6	.000571	.93191	310.1	56.7	.000798	.93975	317.6	72.2	.001012
46	.92476	304.8	36.4	.000512	.93048	311.1	53.3	.000750	.93818	316.6	72.6	.001019
47	.92146	303.3	33.7	.000474	.92689	308.7	60.1	.000847	.93452	316.9	81.3	.001140
48	.93144	322.5	143.6	.002019	.93641	326.2	161.5	.002273	.94371	334.4	173.6	.002434
49	.92221	303.7	31.8	.000447	.92531	308.1	56.5	.000796	.93079	315.3	74.5	.001044
50	.92439	304.2	26.3	.000369	.92426	306.4	48.5	.000683	.93997	316.7	62.4	.000875
51	.92206	303.0	24.9	.000350	.92921	309.7	55.8	.000786	.94229	323.6	94.3	.001322
52	.92394	309.1	54.5	.000766	.92921	315.9	69.7	.000981	.93766	318.0	84.9	.001191
53	.92551	305.8	40.5	.000569	.93041	307.9	47.2	.000664	.93848	314.2	59.3	.000831
54	.92626	305.7	37.8	.000532	.93048	307.8	45.7	.000643	.93818	314.3	58.1	.000816
55	.92521	304.2	30.1	.000423	.92816	307.0	45.2	.000637	.93549	314.6	62.9	.000882
56	.93039	319.5	131.0	.001842	.93573	323.1	147.4	.002074	.94363	331.2	159.5	.002238
57	.92416	305.6	44.9	.000632	.92981	309.6	61.7	.000868	.93848	317.7	78.5	.001101
58	.92664	306.9	42.7	.000601	.92981	309.0	42.3	.000596	.93766	312.8	53.0	.000743
59	.92844	306.4	36.6	.000515	.93071	306.8	36.6	.000515	.93661	312.3	47.1	.000660
60	.92881	318.3	116.3	.001635	.93536	322.5	132.8	.001870	.94334	330.5	143.7	.002015
61	.91547	302.2	40.7	.000572	.92082	307.7	62.9	.000885	.92914	316.3	81.9	.001148
62	.92341	308.4	48.3	.000680	.92659	307.9	44.6	.000628	.93250	313.1	52.4	.000735
63	.93001	310.1	43.8	.000615	.93071	308.0	37.0	.000520	.93250	313.8	55.5	.000779
64	.92596	309.0	45.2	.000635	.93476	316.9	80.7	.001135	.93885	328.1	128.6	.001803
65	.92971	315.7	85.4	.001200	.93251	324.1	147.8	.002080	.93616	331.8	173.8	.002438
66	.91592	313.8	111.1	.001562	.92284	317.9	127.0	.001788	.93026	325.5	136.2	.001910
67	.90347	304.4	79.4	.001116	.90867	307.8	93.6	.001318	.91465	314.6	105.6	.001481
68	.89830	298.3	52.0	.000732	.90245	300.9	62.7	.000882	.90711	306.5	74.7	.001047
69	.91652	299.3	17.2	.000242	.91437	298.5	16.8	.000236	.91114	299.2	19.3	.000271
70	.91599	298.2	14.7	.000207	.91437	297.4	12.3	.000174	.91316	299.5	17.7	.000248
71	.92476	301.9	18.5	.000260	.92456	301.1	16.0	.000226	.91943	303.4	27.5	.000386

[a] h measured in J/m^2-sec-°K

TABLE II.- TABULATION OF HEAT-TRANSFER MEASUREMENTS ON CLEAN MODEL AT A NOMINAL REYNOLDS NUMBER BASED ON MODEL LENGTH OF 3.0×10^6 - Continued

(a) $\alpha = -30^{\circ}$ - Concluded

Thermocouple	$\beta = 5^{\circ}$; $T_w = 388^{\circ}$ K; $p_t = 278.0$ kN/m^2				$\beta = 10^{\circ}$; $T_w = 389^{\circ}$ K; $p_t = 278.5$ kN/m^2							
	$\frac{T_e}{T_t}$	T_w, $^{\circ}$K	h (a)	N_{St}	$\frac{T_e}{T_t}$	T_w, $^{\circ}$K	h (a)	N_{St}	$\frac{T_e}{T_t}$	T_w, $^{\circ}$K	h (a)	N_{St}
1	.97044	364.0	580.5	.008164	.96937	362.9	472.0	.006644				
2	.95165	347.5	395.1	.005556	.95117	347.0	346.5	.004877				
3	.94633	338.2	274.6	.003862	.94593	338.3	251.3	.003536				
4	.94484	333.2	212.9	.002994	.94436	333.5	199.6	.002809				
5	.94311	329.8	180.9	.002544	.94234	329.8	169.9	.002392				
6	.94356	329.6	167.7	.002359	.94234	329.3	156.7	.002205				
7	.93083	324.7	168.6	.002371	.92886	324.2	156.3	.002200				
8	.90658	309.4	118.0	.001660	.90489	309.0	110.9	.001561				
9	.89490	298.7	55.0	.000773	.89298	300.4	56.1	.000790				
10	.91743	298.5	12.3	.000173	.90954	294.9	6.0	.000084				
11	.90927	297.3	20.9	.000294	.90804	295.7	12.5	.000176				
12	.90673	297.9	25.1	.000353	.92219	300.3	12.5	.000175				
13	.97665	369.0	626.7	.008813	.97604	367.9	491.1	.006912				
14	.96131	355.4	429.9	.006046	.96121	355.1	371.2	.005224				
15	.95330	337.2	220.7	.003103	.95320	337.9	207.6	.002921				
16	.95097	331.4	119.1	.001675	.94953	327.8	121.5	.001711				
17	.94873	321.8	89.3	.001255	.94398	321.3	92.1	.001297				
18	.94723	319.1	70.3	.000989	.95282	323.2	60.1	.000846				
19	.95060	319.9	53.2	.000749	.94953	342.0	243.5	.003428				
20	.95165	334.0	200.7	.002823	.95102	335.1	200.9	.002827				
21	.94012	328.0	176.3	.002479	.94159	329.5	175.1	.002464				
22	.93742	324.9	158.6	.002230	.94024	327.0	161.1	.002268				
23	.93885	324.6	148.5	.002089	.94174	326.4	150.8	.002122				
24	.96977	361.9	525.5	.007390	.97319	363.9	460.6	.006483				
25	.96108	353.3	435.1	.006119	.96533	356.1	403.0	.005673				
26	.95494	343.1	293.1	.004121	.95986	347.4	293.9	.004137				
27	.94805	337.8	242.6	.003412	.95117	341.4	249.2	.003508				
28	.93608	331.7	213.8	.003006	.94166	335.9	219.4	.003088				
29	.93458	329.2	192.5	.002708	.94084	333.7	200.8	.002826				
30	.93323	327.9	192.2	.002704	.94054	332.6	200.9	.002828				
31	.96707	361.4	531.0	.007468	.97072	363.5	464.2	.006534				
32	.95075	342.8	315.5	.004437	.95701	347.8	316.8	.004459				
33	.94573	332.3	210.0	.002953	.95312	338.3	223.9	.003151				
34	.94431	331.3	193.7	.002724	.95110	337.1	209.6	.002950				
35	.93982	329.7	193.7	.002724	.94518	335.0	209.8	.002953				
36	.93600	327.0	184.0	.002588	.94069	331.8	198.3	.002792				
37	.95120	348.4	394.8	.005552	.95567	351.8	374.2	.005267				
38	.94326	332.6	182.7	.002569	.94990	332.8	200.6	.002824				
39	.94236	327.4	138.6	.001949	.94968	337.9	160.2	.002254				
40	.94049	322.7	139.6	.001963	.94743	328.4	156.6	.002205				
41	.93892	321.9	136.9	.001925	.94503	327.2	152.8	.002151				
42	.93593	320.4	132.2	.001859	.94129	325.2	146.5	.002062				
43	.94573	337.1	261.0	.003670	.95087	341.4	262.6	.003697				
44	.94251	325.1	118.7	.001669	.94960	326.0	126.0	.001773				
45	.94207	318.2	85.2	.001198	.94945	323.4	102.6	.001445				
46	.93989	317.3	92.6	.001302	.94668	322.4	106.8	.001504				
47	.93570	317.3	103.3	.001453	.94144	321.6	116.0	.001633				
48	.94446	333.3	209.8	.002950	.94998	337.7	214.5	.003019				
49	.93098	315.1	93.0	.001307	.93769	319.2	100.9	.001420				
50	.94334	317.0	62.0	.000872	.94563	319.5	75.6	.001064				
51	.94236	326.9	111.0	.001560	.94893	327.1	83.5	.001176				
52	.94012	318.1	94.8	.001334	.94728	322.7	111.2	.001566				
53	.94117	314.2	68.5	.000963	.94840	325.3	87.6	.001233				
54	.94072	314.9	73.0	.001027	.94788	319.8	86.0	.001211				
55	.93712	315.4	82.9	.001166	.94324	320.0	95.7	.001347				
56	.94446	330.3	192.9	.002713	.94968	334.7	200.2	.002818				
57	.94132	318.3	95.8	.001348	.94863	323.2	106.9	.001504				
58	.94057	315.2	60.7	.000853	.94795	317.0	68.1	.000959				
59	.93892	312.8	60.6	.000852	.94563	317.8	73.2	.001030				
60	.94439	329.7	173.9	.002445	.94960	333.9	179.9	.002532				
61	.93218	317.4	105.3	.001480	.93934	322.2	115.6	.001627				
62	.93390	313.3	66.6	.000936	.94099	316.8	70.8	.000997				
63	.93143	313.7	77.3	.001087	.93709	317.6	86.9	.001223				
64	.93772	330.1	196.3	.002760	.94324	330.8	171.7	.002416				
65	.93660	331.8	227.5	.003199	.94234	337.5	248.5	.003497				
66	.93046	324.1	164.8	.002318	.93455	327.4	167.6	.002359				
67	.91406	313.1	125.3	.001763	.91702	316.2	132.9	.001871				
68	.90560	304.8	87.0	.001224	.90774	307.4	96.0	.001351				
69	.90231	296.7	22.5	.000316	.90055	297.9	30.3	.000426				
70	.90815	297.7	22.5	.000316	.91043	300.5	26.6	.000375				
71	.91317	301.6	40.3	.000567	.91628	305.4	55.0	.000775				

[a] h measured in J/m^2-sec-$^{\circ}$K

TABLE II.- TABULATION OF HEAT-TRANSFER MEASUREMENTS ON CLEAN MODEL AT A NOMINAL REYNOLDS NUMBER BASED ON MODEL LENGTH OF 3.0×10^6 - Continued

(b) $\alpha = -15^\circ$

Thermocouple	$\beta = -10^\circ$; $T_w = 386^\circ$ K; $p_t = 277.7$ kN/m^2				$\beta = -5^\circ$; $T_w = 390^\circ$ K; $p_t = 279.0$ kN/m^2				$\beta = 0^\circ$; $T_w = 390^\circ$ K; $p_t = 279.9$ kN/m^2			
	$\frac{T_e}{T_t}$	T_w, $^\circ$K	h (a)	N_{St}	$\frac{T_e}{T_t}$	T_w, $^\circ$K	h (a)	N_{St}	$\frac{T_e}{T_t}$	T_w, $^\circ$K	h (a)	N_{St}
1	.98294	364.1	578.9	.008128	.98189	366.2	534.6	.007511	.98071	374.6	594.5	.008336
2	.97386	354.8	465.9	.006541	.97248	357.0	429.3	.006031	.97112	357.4	483.6	.006782
3	.96980	348.1	358.4	.005032	.96901	350.4	338.1	.004749	.96813	351.2	374.1	.005246
4	.96732	343.5	294.5	.004134	.96638	345.6	280.9	.003947	.96588	346.4	306.4	.004296
5	.96274	338.6	250.6	.003518	.96247	340.8	240.9	.003384	.96184	341.4	259.7	.003642
6	.96041	337.1	231.6	.003251	.96028	339.2	222.1	.003121	.95975	340.1	240.6	.003373
7	.94696	331.9	233.9	.003284	.94643	333.7	223.5	.003140	.94567	334.5	242.5	.003401
8	.92156	317.3	175.6	.002465	.92077	318.3	168.9	.002373	.91970	319.0	180.1	.002525
9	.90653	305.8	89.2	.001252	.90541	309.4	91.8	.001290	.90413	303.6	91.7	.001285
10	.91570	299.2	29.1	.000408	.91986	300.0	25.7	.000361	.92179	300.6	17.4	.000244
11	.93809	306.1	17.2	.000242	.94199	307.7	20.1	.000283	.93654	308.9	35.6	.000499
12	.94673	310.5	34.4	.000483	.95313	316.8	61.8	.000868	.94343	312.4	44.3	.000621
13	.97717	361.5	531.8	.007467	.97677	363.8	496.9	.006982	.97599	372.2	542.7	.007609
14	.95019	337.4	287.3	.004033	.94929	339.6	274.6	.003857	.94859	340.3	299.9	.004206
15	.93959	318.5	112.8	.001584	.93891	319.4	120.1	.001687	.93789	320.3	127.4	.001787
16	.93674	314.4	62.1	.000872	.93665	316.5	57.7	.000811	.93579	314.1	56.7	.000796
17	.93719	309.9	52.4	.000736	.94019	310.1	43.8	.000615	.94103	310.7	32.1	.000450
18	.94989	315.2	45.5	.000638	.95027	314.5	40.5	.000569	.95256	314.6	21.6	.000303
19	.94200	324.3	156.2	.002194	.94636	321.4	94.6	.001330	.95076	320.4	68.0	.000953
20	.93358	310.1	69.2	.000971	.93567	312.3	77.3	.001087	.93721	316.4	97.6	.001368
21	.93644	309.9	57.0	.000801	.93913	312.4	65.0	.000913	.93789	316.9	96.4	.001352
22	.95026	317.9	66.4	.000932	.94124	313.7	67.5	.000948	.93265	313.9	90.2	.001265
23	.94080	321.2	140.8	.001977	.93718	313.2	74.3	.001044	.92853	311.7	83.2	.001167
24	.95665	343.7	359.8	.005052	.95893	348.5	355.5	.004994	.96124	361.3	422.2	.005921
25	.94365	329.8	241.7	.003393	.94553	334.3	255.7	.003593	.94762	337.8	299.4	.004198
26	.93418	316.1	119.1	.001672	.93687	320.4	137.4	.001930	.93976	324.9	166.1	.002328
27	.92862	309.3	72.6	.001019	.93462	315.7	95.5	.001341	.93834	321.6	128.7	.001805
28	.93080	308.7	59.1	.000830	.93650	316.6	98.4	.001382	.93721	328.4	127.0	.001781
29	.94343	314.2	60.8	.000853	.93492	315.5	94.6	.001329	.93115	324.9	118.8	.001665
30	.92817	314.5	120.3	.001698	.92995	313.5	91.6	.001287	.92666	322.5	116.9	.001639
31	.96319	350.0	416.2	.005844	.96593	355.0	421.8	.005927	.96880	367.2	489.1	.006858
32	.93802	328.5	184.5	.002590	.94124	328.3	202.8	.002849	.94530	333.4	245.5	.003443
33	.93125	310.2	77.4	.001086	.93484	314.4	101.7	.001428	.93864	319.6	127.6	.001789
34	.92907	307.4	57.2	.000804	.93364	312.3	78.7	.001106	.93804	318.3	105.4	.001478
35	.92637	307.6	52.3	.000734	.93176	311.1	74.2	.001043	.93639	317.6	103.0	.001445
36	.92659	304.6	42.3	.000594	.93326	311.2	71.0	.000997	.93759	317.6	100.8	.001414
37	.95026	338.4	312.0	.004380	.95396	344.2	320.7	.004505	.95645	347.8	386.1	.005415
38	.93215	316.6	103.5	.001453	.93627	317.1	116.3	.001634	.94028	322.1	148.5	.002083
39	.92922	307.4	57.7	.000810	.93319	314.5	77.9	.001094	.93804	315.9	96.1	.001348
40	.92742	304.6	42.2	.000592	.93146	310.1	56.9	.000799	.93609	312.3	73.6	.001032
41	.92764	303.7	34.0	.000477	.93191	311.0	50.1	.000704	.93654	311.8	67.8	.000951
42	.92832	304.2	28.5	.000400	.93311	310.5	45.0	.000632	.93759	311.8	63.0	.000883
43	.94395	329.0	219.6	.003084	.94786	334.7	240.8	.003383	.95226	339.5	288.0	.004039
44	.92900	308.4	66.6	.000935	.93364	316.8	90.2	.001268	.93856	318.5	118.1	.001656
45	.92787	305.0	38.9	.000546	.93206	314.4	52.3	.000735	.93684	312.1	61.5	.000863
46	.92787	304.1	34.9	.000489	.93153	309.5	41.4	.000581	.93646	310.0	50.5	.000709
47	.92847	303.4	28.6	.000401	.93191	307.8	35.0	.000491	.93609	308.6	41.0	.000575
48	.94102	325.6	192.2	.002698	.94530	331.2	205.7	.002890	.95009	336.3	247.2	.003467
49	.93606	306.6	30.2	.000425	.93861	307.1	27.3	.000384	.94223	311.9	42.6	.000597
50	.94162	309.1	36.4	.000512	.93868	308.3	40.2	.000565	.94051	312.0	55.4	.000776
51	.94395	314.1	62.2	.000873	.93740	308.7	40.1	.000564	.94118	312.3	45.5	.000637
52	.92419	305.2	54.1	.000760	.92905	316.4	81.4	.001144	.93444	315.5	104.8	.001470
53	.92471	303.1	36.7	.000515	.92920	311.5	56.4	.000793	.93459	312.2	76.2	.001068
54	.92569	303.5	36.1	.000507	.92905	305.5	45.9	.000645	.93429	310.4	61.7	.000865
55	.92757	304.0	35.2	.000494	.92995	305.0	38.2	.000537	.93474	309.4	50.3	.000705
56	.93944	322.8	179.9	.002526	.94380	328.0	193.2	.002714	.94859	332.8	229.1	.003212
57	.92066	304.0	53.4	.000750	.92649	314.7	77.6	.001091	.93280	314.6	100.5	.001409
58	.92096	301.1	30.6	.000430	.92604	309.9	52.4	.000736	.93197	311.5	73.4	.001030
59	.92359	303.0	29.2	.000410	.92679	304.8	43.4	.000610	.93152	310.1	60.9	.000853
60	.93659	321.1	161.8	.002272	.94124	326.2	173.9	.002443	.94582	330.9	205.5	.002882
61	.91111	302.1	62.8	.000882	.91685	306.5	80.5	.001130	.92277	312.0	103.7	.001454
62	.91479	300.8	42.5	.000596	.91941	304.6	56.4	.000793	.92381	309.9	76.3	.001070
63	.93313	308.1	45.2	.000635	.93228	309.1	54.3	.000763	.93399	313.4	72.1	.001012
64	.94102	314.5	82.1	.001153	.94493	318.4	89.8	.001261	.94650	322.8	116.1	.001628
65	.94095	313.5	72.9	.001024	.94350	315.5	66.8	.000938	.94283	320.4	101.0	.001416
66	.92501	317.1	158.8	.002230	.92890	321.7	169.3	.002379	.93265	326.0	199.6	.002799
67	.91119	307.4	111.7	.001568	.91429	311.1	126.0	.001770	.91700	315.1	151.4	.002123
68	.90412	300.6	71.4	.001002	.90662	303.4	87.0	.001222	.90907	307.0	104.7	.001468
69	.92156	298.5	11.4	.000160	.92107	299.9	20.9	.000293	.91805	302.7	36.1	.000506
70	.93644	307.4	33.3	.000468	.94342	310.3	22.0	.000309	.93834	308.8	29.3	.000411
71	.94598	314.6	66.4	.000932	.95246	315.3	49.8	.000699	.94545	313.9	53.2	.000747

[a] h measured in J/m^2-sec-$^\circ$K

TABLE II.- TABULATION OF HEAT-TRANSFER MEASUREMENTS ON CLEAN MODEL AT A NOMINAL REYNOLDS NUMBER BASED ON MODEL LENGTH OF 3.0×10^6 - Continued

(b) $\alpha = -15^{\circ}$ - Concluded

Thermocouple	$\beta = 5^{\circ}$; $T_w = 388^{\circ}$ K; $p_t = 278.1$ kN/m^2				$\beta = 10^{\circ}$; $T_w = 391^{\circ}$ K; $p_t = 277.2$ kN/m^2							
	$\frac{T_e}{T_t}$	T_w, $^{\circ}$K	h (a)	N_{St}	$\frac{T_e}{T_t}$	T_w, $^{\circ}$K	h (a)	N_{St}	$\frac{T_e}{T_t}$	T_w, $^{\circ}$K	h (a)	N_{St}
1	.97983	376.9	567.9	.007986	.97493	363.6	559.9	.007935				
2	.97041	354.0	487.7	.006858	.96604	354.9	453.3	.006423				
3	.96757	348.1	379.2	.005333	.96343	349.5	360.3	.005106				
4	.96532	343.5	310.7	.004370	.96113	345.1	298.0	.004222				
5	.96128	338.8	263.1	.003700	.95718	340.3	251.3	.003561				
6	.95918	337.5	244.0	.003432	.95495	339.0	233.9	.003315				
7	.94518	332.0	245.3	.003450	.94109	333.5	235.1	.003331				
8	.91919	316.8	180.2	.002535	.91592	318.5	174.3	.002470				
9	.90391	305.5	92.6	.001302	.90073	307.0	93.2	.001321				
10	.91881	299.9	21.1	.000297	.91093	300.4	28.1	.000398				
11	.94330	310.4	30.6	.000431	.93588	308.8	21.1	.000299				
12	.95259	317.1	67.5	.000950	.94497	313.2	39.5	.000560				
13	.97551	374.9	525.5	.007390	.97133	362.1	520.4	.007374				
14	.94847	337.3	298.9	.004204	.94541	339.5	290.2	.004112				
15	.93791	323.4	125.9	.001770	.93499	325.6	128.7	.001823				
16	.93566	311.4	62.0	.000871	.93186	313.6	68.0	.000964				
17	.93896	310.3	46.6	.000655	.93164	311.8	56.8	.000805				
18	.94885	314.0	41.3	.000581	.94027	314.7	46.8	.000663				
19	.94750	319.0	73.7	.001036	.93640	326.4	156.3	.002215				
20	.93806	316.9	113.5	.001596	.93514	319.7	122.7	.001738				
21	.93477	315.4	108.1	.001520	.92814	316.2	111.8	.001584				
22	.92907	311.7	95.0	.001337	.92501	312.7	93.7	.001328				
23	.92952	310.8	84.7	.001191	.92620	311.8	83.6	.001185				
24	.96532	351.6	456.2	.006415	.96507	355.4	448.3	.006353				
25	.95139	337.9	319.8	.004497	.95197	342.7	330.4	.004683				
26	.94398	326.7	191.1	.002688	.94556	332.2	207.5	.002940				
27	.94255	324.1	159.0	.002236	.94266	329.3	175.9	.002492				
28	.93686	321.9	153.8	.002163	.93313	325.0	160.8	.002278				
29	.93095	318.4	138.7	.001951	.92828	321.4	149.0	.002111				
30	.92795	329.4	126.6	.001780	.92523	329.6	138.4	.001961				
31	.97289	372.9	496.6	.006984	.97286	362.0	522.9	.007410				
32	.95102	335.2	272.8	.003837	.95353	341.8	297.6	.004217				
33	.94518	322.4	148.9	.002094	.94891	329.2	169.6	.002403				
34	.94473	321.8	130.7	.001838	.94832	328.6	150.3	.002130				
35	.94255	321.1	132.3	.001860	.94541	327.9	151.4	.002146				
36	.94270	320.6	127.1	.001787	.94430	326.2	142.0	.002013				
37	.96225	349.3	425.9	.005989	.96366	354.2	431.1	.006109				
38	.94667	330.3	175.9	.002474	.95055	337.3	202.7	.002872				
39	.94450	322.8	116.2	.001635	.94869	329.4	136.1	.001929				
40	.94293	318.6	90.5	.001272	.94735	325.2	108.3	.001535				
41	.94345	315.0	83.6	.001176	.94750	321.3	101.5	.001439				
42	.94390	315.0	79.6	.001119	.94690	320.7	95.4	.001352				
43	.95753	340.8	319.9	.004499	.95956	346.7	335.6	.004756				
44	.94585	321.6	136.6	.001921	.95018	328.3	156.5	.002217				
45	.94420	318.0	75.6	.001063	.94891	324.0	87.4	.001239				
46	.94368	315.2	61.3	.000863	.94824	320.7	72.4	.001025				
47	.94300	313.5	52.8	.000743	.94713	319.1	66.4	.000941				
48	.95589	338.1	278.1	.003912	.95807	344.0	292.7	.004148				
49	.94847	315.9	60.5	.000851	.95107	322.2	76.9	.001090				
50	.94330	313.7	69.0	.000970	.94467	318.7	83.9	.001189				
51	.93671	311.0	62.5	.000879	.93633	315.4	76.2	.001079				
52	.94196	318.9	124.2	.001746	.94668	325.6	142.6	.002021				
53	.94218	315.5	92.0	.001293	.94705	321.7	107.0	.001517				
54	.94210	313.7	75.2	.001058	.94690	319.6	87.2	.001236				
55	.94196	312.5	61.3	.000862	.94675	318.2	72.7	.001031				
56	.95409	334.4	255.9	.003598	.95606	340.0	271.5	.003847				
57	.94053	318.1	120.3	.001692	.94541	324.7	138.9	.001969				
58	.93986	314.9	89.4	.001258	.94452	320.8	102.6	.001454				
59	.93971	313.4	73.6	.001035	.94482	319.0	83.6	.001184				
60	.95124	332.5	229.3	.003225	.95316	338.0	242.5	.003436				
61	.92997	315.1	123.2	.001733	.93469	321.6	140.3	.001988				
62	.93020	312.7	93.0	.001308	.93439	318.7	106.2	.001505				
63	.94255	316.5	79.3	.001115	.94243	320.0	91.3	.001293				
64	.95109	325.4	142.9	.002010	.95063	329.2	148.2	.002101				
65	.94315	336.0	130.2	.001831	.93558	328.8	197.6	.002800				
66	.93769	327.2	221.4	.003113	.93931	332.2	228.6	.003240				
67	.92128	316.4	167.3	.002352	.92292	321.4	179.7	.002547				
68	.91290	308.1	115.6	.001626	.91414	312.9	129.6	.001836				
69	.91649	302.6	44.0	.000618	.91488	305.1	50.5	.000716				
70	.94143	310.6	37.3	.000524	.93677	311.6	39.5	.000560				
71	.94196	313.7	67.1	.000944	.93648	317.4	90.8	.001286				

[a] h measured in J/m^2-sec-$^{\circ}$K

TABLE II.- TABULATION OF HEAT-TRANSFER MEASUREMENTS ON CLEAN MODEL AT A NOMINAL REYNOLDS NUMBER BASED ON MODEL LENGTH OF 3.0×10^6 - Continued

(c) $\alpha = -10^{\circ}$

Thermocouple	$\beta = 0^{\circ}$; $T_w = 391^{\circ}$ K; $p_t = 279.5$ kN/m^2											
	$\frac{T_e}{T_t}$	T_w, $^{\circ}$K	h (a)	N_{St}	$\frac{T_e}{T_t}$	T_w, $^{\circ}$K	h (a)	N_{St}	$\frac{T_e}{T_t}$	T_w, $^{\circ}$K	h (a)	N_{St}
1	.98338	373.7	519.1	.007286								
2	.97741	368.6	459.3	.006448								
3	.97493	353.8	375.0	.005265								
4	.97215	348.9	312.5	.004387								
5	.96772	343.7	266.1	.003736								
6	.96592	342.7	249.5	.003502								
7	.95360	337.7	252.0	.003537								
8	.92835	322.8	193.8	.002721								
9	.91243	307.3	104.1	.001461								
10	.92437	302.1	26.9	.000378								
11	.93534	305.3	22.3	.000313								
12	.94638	309.3	23.6	.000332								
13	.97538	369.4	456.8	.006412								
14	.94518	334.9	251.5	.003530								
15	.93436	315.0	94.6	.001328								
16	.93218	307.0	38.3	.000538								
17	.93887	306.1	21.4	.000300								
18	.95435	313.2	19.4	.000272								
19	.95495	319.4	67.3	.000944								
20	.93339	311.0	71.3	.001001								
21	.93617	311.8	68.2	.000958								
22	.93767	311.2	63.1	.000886								
23	.93602	310.2	57.4	.000806								
24	.96066	358.0	363.1	.005098								
25	.94608	333.5	255.5	.003587								
26	.93804	320.5	136.3	.001913								
27	.93557	315.8	95.6	.001342								
28	.93767	322.2	90.1	.001264								
29	.93962	320.4	97.0	.001362								
30	.93639	317.4	103.2	.001449								
31	.97118	366.1	432.6	.006073								
32	.94653	331.7	224.4	.003150								
33	.93932	317.2	111.6	.001567								
34	.93767	314.2	83.7	.001175								
35	.93557	312.7	76.6	.001076								
36	.93692	311.5	65.3	.000916								
37	.96051	348.2	366.3	.005142								
38	.94218	327.1	150.9	.002119								
39	.93940	319.7	98.9	.001388								
40	.93722	311.5	67.7	.000950								
41	.93722	310.0	55.9	.000785								
42	.93812	310.8	46.4	.000651								
43	.95675	340.9	288.3	.004047								
44	.94060	318.5	118.2	.001659								
45	.93827	312.1	66.0	.000926								
46	.93752	310.2	56.1	.000788								
47	.93692	309.1	49.3	.000692								
48	.95487	337.9	250.2	.003512								
49	.94210	311.1	47.5	.000667								
50	.95525	323.2	100.9	.001417								
51	.94578	323.1	131.2	.001841								
52	.93647	315.6	102.6	.001440								
53	.93632	312.3	78.0	.001096								
54	.93572	310.8	66.5	.000933								
55	.93572	310.2	59.4	.000834								
56	.95315	334.3	234.1	.003287								
57	.93466	314.6	102.2	.001435								
58	.93384	311.4	74.4	.001045								
59	.93361	310.3	64.8	.000910								
60	.95074	332.6	210.9	.002961								
61	.92617	312.7	105.4	.001480								
62	.92798	310.2	74.6	.001048								
63	.93767	312.8	64.6	.000906								
64	.94849	316.9	62.2	.000873								
65	.94676	320.1	100.0	.001404								
66	.93947	328.4	206.2	.002894								
67	.92430	317.9	159.7	.002241								
68	.91648	309.8	113.0	.001587								
69	.92520	304.6	38.7	.000543								
70	.94909	313.8	41.6	.000584								
71	.94834	318.4	84.6	.001187								

[a] h measured in J/m^2-sec-$^{\circ}$K

TABLE II.- TABULATION OF HEAT-TRANSFER MEASUREMENTS ON CLEAN MODEL AT A NOMINAL REYNOLDS NUMBER BASED ON MODEL LENGTH OF 3.0×10^6 - Continued

(d) $\alpha = -5^\circ$

Thermocouple	$\beta = -10^\circ$; $T_w = 388^\circ$ K; $p_t = 279.5$ kN/m^2				$\beta = -5^\circ$; $T_w = 390^\circ$ K; $p_t = 279.0$ kN/m^2				$\beta = 0^\circ$; $T_w = 388^\circ$ K; $p_t = 279.0$ kN/m^2			
	$\frac{T_e}{T_t}$	T_w, $^\circ$K	h (a)	N_{St}	$\frac{T_e}{T_t}$	T_w, $^\circ$K	h (a)	N_{St}	$\frac{T_e}{T_t}$	T_w, $^\circ$K	h (a)	N_{St}
1	.98384	363.8	434.7	.006080	.98123	366.7	530.2	.007451	.98105	365.0	553.8	.007761
2	.98198	360.2	408.7	.005716	.97872	363.4	504.4	.007087	.97868	360.9	499.5	.007000
3	.97911	355.5	348.2	.004869	.97640	358.7	413.2	.005806	.97684	356.2	410.6	.005754
4	.97610	350.5	294.7	.004121	.97317	353.5	342.1	.004807	.97392	351.1	340.3	.004769
5	.97233	345.7	253.2	.003542	.96956	348.4	281.1	.003950	.96988	345.9	287.3	.004027
6	.97203	345.1	237.3	.003320	.96896	347.8	262.9	.003694	.96943	345.5	270.1	.003785
7	.96224	341.1	240.3	.003361	.95898	343.5	264.0	.003710	.95916	341.4	274.5	.003847
8	.93805	327.2	192.9	.002698	.93495	329.2	209.3	.002942	.93504	327.3	214.4	.003004
9	.92298	316.5	116.9	.001635	.91941	313.5	129.6	.001821	.91954	316.7	128.6	.001802
10	.92652	307.9	42.4	.000593	.92504	305.4	43.5	.000611	.92620	307.1	41.6	.000583
11	.94461	312.4	40.8	.000570	.93082	305.4	29.3	.000412	.93197	305.2	26.0	.000364
12	.94890	319.4	90.8	.001269	.95087	317.2	50.1	.000704	.94006	306.9	19.7	.000275
13	.97203	357.1	371.2	.005191	.96941	360.2	454.6	.006388	.96973	358.4	467.2	.006547
14	.94144	330.2	202.5	.002833	.93818	332.6	225.0	.003162	.93841	330.2	226.6	.003175
15	.93059	314.8	77.2	.001079	.92774	312.1	86.3	.001212	.92778	318.2	84.4	.001183
16	.92682	306.0	33.2	.000464	.92421	304.1	30.5	.000428	.92448	305.1	29.2	.000409
17	.93556	306.8	28.7	.000402	.93277	306.5	27.2	.000382	.93272	305.4	18.5	.000260
18	.94295	315.8	62.7	.000877	.94373	317.8	68.9	.000969	.95070	317.5	57.3	.000803
19	.94212	316.6	75.3	.001053	.93908	318.2	86.5	.001216	.95325	318.3	64.6	.000906
20	.92698	305.3	36.6	.000512	.92459	304.7	42.4	.000596	.92508	307.8	48.7	.000682
21	.93541	305.5	21.8	.000305	.93172	305.5	30.0	.000421	.92957	308.8	37.7	.000528
22	.95109	313.9	45.5	.000636	.94223	309.0	31.6	.000443	.94156	310.0	30.9	.000432
23	.95048	316.5	66.0	.000923	.94914	312.5	35.5	.000499	.93969	309.7	28.7	.000402
24	.95199	340.1	273.3	.003823	.95214	345.3	342.6	.004814	.95534	345.5	355.7	.004984
25	.93820	325.1	186.6	.002610	.93758	329.5	219.6	.003086	.94036	329.8	235.2	.003296
26	.92999	317.5	85.2	.001192	.92909	314.7	102.4	.001440	.93197	316.5	117.4	.001645
27	.92705	307.2	37.6	.000525	.92541	307.2	53.8	.000757	.92718	309.7	70.3	.000986
28	.93436	304.2	22.7	.000317	.93067	307.9	42.6	.000599	.93070	309.9	58.3	.000818
29	.95094	312.7	33.7	.000471	.94208	311.8	41.9	.000589	.94201	314.0	56.8	.000796
30	.94687	317.5	76.0	.001064	.94636	317.7	67.8	.000953	.93819	315.3	72.6	.001018
31	.96359	349.9	332.6	.004652	.96431	355.5	422.0	.005930	.96838	356.2	452.7	.006344
32	.93745	322.8	163.0	.002280	.93863	328.6	199.8	.002808	.94343	336.5	225.6	.003161
33	.93059	312.1	69.3	.000969	.93120	313.3	94.7	.001331	.93557	320.0	107.9	.001512
34	.92863	308.2	47.6	.000666	.92872	309.7	65.6	.000922	.93302	312.6	79.7	.001117
35	.92667	308.1	42.2	.000590	.92632	308.2	58.2	.000818	.93077	311.3	73.9	.001035
36	.92788	306.0	30.8	.000431	.92752	306.7	46.4	.000652	.93115	309.5	60.3	.000846
37	.95372	341.8	282.0	.003944	.95537	348.1	360.4	.005064	.95939	348.5	381.8	.005351
38	.93263	318.5	106.9	.001495	.93488	319.7	141.0	.001982	.93976	332.4	164.6	.002306
39	.92901	311.5	67.0	.000938	.93090	313.1	92.7	.001303	.93677	320.1	103.9	.001456
40	.92698	307.5	47.6	.000666	.92797	308.9	64.7	.000909	.93369	314.9	76.6	.001074
41	.92698	307.6	41.0	.000573	.92767	307.2	53.7	.000754	.93332	313.0	65.1	.000912
42	.92758	304.3	29.1	.000407	.92797	305.9	43.0	.000604	.93347	313.7	56.8	.000796
43	.94905	334.6	230.9	.003229	.95132	341.0	276.9	.003891	.95669	342.4	309.7	.004340
44	.92961	317.3	85.7	.001198	.93232	315.6	108.7	.001528	.93841	323.4	122.9	.001723
45	.92713	306.5	39.6	.000554	.92917	308.9	58.0	.000815	.93557	315.5	70.5	.000987
46	.92577	303.1	32.6	.000456	.92767	306.9	49.9	.000702	.93414	313.2	62.9	.000882
47	.92487	302.1	28.1	.000394	.92632	306.0	45.8	.000644	.93324	309.9	58.6	.000821
48	.94702	331.5	202.1	.002827	.94914	337.7	242.7	.003410	.95474	339.3	270.8	.003794
49	.92976	304.6	32.8	.000458	.93045	308.0	47.6	.000669	.93751	311.7	57.5	.000805
50	.94724	312.8	43.5	.000609	.94606	313.2	41.4	.000581	.95152	316.4	47.8	.000670
51	.94830	316.9	69.3	.000969	.94614	316.1	58.1	.000817	.94860	316.9	51.0	.000714
52	.92479	310.5	70.4	.000985	.92782	312.5	96.5	.001357	.93482	324.2	115.9	.001624
53	.92441	306.0	45.7	.000639	.92737	308.6	67.7	.000951	.93444	315.7	80.8	.001132
54	.92366	305.9	39.0	.000545	.92647	307.2	56.3	.000791	.93347	313.8	69.9	.000979
55	.92374	304.0	34.3	.000480	.92609	306.7	51.3	.000721	.93302	310.5	64.2	.000899
56	.94649	328.6	191.1	.002673	.94847	334.4	229.4	.003224	.95392	336.0	251.7	.003528
57	.92321	309.6	68.6	.000960	.92662	311.8	93.5	.001314	.93377	319.2	106.2	.001488
58	.92148	305.1	44.8	.000627	.92526	307.6	63.2	.000888	.93264	314.5	75.5	.001057
59	.92208	305.7	38.8	.000542	.92541	306.7	52.3	.000735	.93212	315.6	67.6	.000948
60	.94521	327.5	172.3	.002409	.94734	333.1	205.6	.002889	.95265	334.6	226.5	.003174
61	.91695	311.1	74.6	.001043	.92016	310.5	94.9	.001334	.92718	314.1	111.9	.001568
62	.91839	303.1	48.6	.000680	.92144	307.5	63.0	.000885	.92882	311.3	76.1	.001066
63	.92841	304.5	34.8	.000487	.93037	309.3	54.3	.000763	.94066	315.1	64.7	.000907
64	.94385	309.6	27.6	.000386	.94434	313.0	40.8	.000574	.94755	318.0	63.6	.000892
65	.94837	315.7	57.4	.000802	.94396	317.2	72.8	.001023	.94545	326.6	97.0	.001359
66	.93692	324.6	169.6	.002372	.93908	329.8	198.2	.002785	.94373	331.3	222.3	.003116
67	.92366	315.1	131.4	.001838	.92511	319.7	156.1	.002193	.92912	321.3	174.1	.002440
68	.91688	311.5	92.2	.001289	.91761	311.8	114.7	.001611	.92148	317.8	126.9	.001778
69	.92456	302.8	25.5	.000357	.92406	302.5	27.1	.000381	.92823	307.8	38.9	.000545
70	.93587	307.6	35.9	.000502	.93330	304.5	21.0	.000296	.94703	312.6	32.7	.000458
71	.95048	316.9	62.5	.000874	.94516	310.7	25.8	.000363	.94800	320.0	83.1	.001165

[a] h measured in J/m^2-sec-$^\circ$K

TABLE II.- TABULATION OF HEAT-TRANSFER MEASUREMENTS ON CLEAN MODEL AT A NOMINAL REYNOLDS NUMBER BASED ON MODEL LENGTH OF 3.0×10^6 - Continued

(d) $\alpha = -5^\circ$ - Concluded

Thermo-couple	$\beta = 5^\circ$; $T_w = 390^\circ$ K; $p_t = 277.7$ kN/m^2				$\beta = 10^\circ$; $T_w = 388^\circ$ K; $p_t = 276.7$ kN/m^2							
	$\frac{T_e}{T_t}$	T_w, $^\circ$K	h (a)	N_{St}	$\frac{T_e}{T_t}$	T_w, $^\circ$K	h (a)	N_{St}	$\frac{T_e}{T_t}$	T_w, $^\circ$K	h (a)	N_{St}
1	.97871	367.4	625.4	.008831	.97467	361.2	507.9	.007168				
2	.97699	363.9	559.4	.007899	.97274	357.4	464.5	.006556				
3	.97542	359.6	459.0	.006481	.97131	353.6	390.3	.005509				
4	.97249	354.5	374.8	.005293	.96861	348.8	324.7	.004583				
5	.96851	349.2	314.1	.004436	.96445	343.9	275.3	.003886				
6	.96814	348.7	292.7	.004134	.96415	343.5	258.9	.003654				
7	.95804	344.3	295.1	.004167	.95436	339.3	261.1	.003685				
8	.93419	330.1	225.9	.003190	.93061	325.9	204.1	.002880				
9	.91873	315.0	136.5	.001928	.91518	312.1	117.2	.001655				
10	.92534	307.5	42.5	.000599	.91889	305.3	40.3	.000568				
11	.93248	308.4	30.2	.000426	.93670	313.6	46.2	.000652				
12	.95306	319.3	46.1	.000651	.94174	319.5	94.2	.001330				
13	.96822	361.2	513.9	.007257	.96497	355.6	437.4	.006173				
14	.93760	332.9	235.1	.003320	.93462	329.2	217.7	.003073				
15	.92705	317.6	88.1	.001243	.92341	311.8	75.0	.001059				
16	.92334	308.0	34.0	.000480	.91889	305.3	33.0	.000466				
17	.93255	308.4	26.0	.000367	.92497	306.3	27.8	.000392				
18	.94764	320.9	68.5	.000967	.94041	314.2	37.4	.000527				
19	.94429	321.0	84.6	.001195	.93299	316.6	82.4	.001163				
20	.92341	309.0	61.5	.000868	.91941	307.8	61.4	.000866				
21	.92728	308.1	44.2	.000624	.91963	306.3	46.6	.000657				
22	.93775	312.0	36.5	.000515	.92453	307.4	43.9	.000620				
23	.93032	309.3	34.8	.000492	.91674	304.7	40.4	.000571				
24	.95796	351.2	406.9	.005746	.95799	348.3	376.9	.005320				
25	.94295	335.7	270.7	.003822	.94271	333.8	260.2	.003672				
26	.93448	322.4	142.1	.002007	.93440	322.4	148.3	.002093				
27	.92906	315.8	93.0	.001313	.92853	316.8	106.9	.001509				
28	.93121	314.7	74.9	.001058	.92891	314.9	85.9	.001213				
29	.94028	318.5	74.7	.001054	.93299	316.9	87.4	.001233				
30	.93136	321.6	85.1	.001201	.92238	314.8	95.2	.001344				
31	.97127	362.1	531.5	.007506	.97195	359.1	475.6	.006713				
32	.94816	338.3	270.7	.003823	.95050	337.9	266.4	.003760				
33	.94073	323.2	137.2	.001938	.94352	324.5	144.3	.002036				
34	.93805	319.7	102.3	.001445	.94093	321.6	114.4	.001615				
35	.93508	318.2	96.5	.001363	.93803	320.3	110.4	.001559				
36	.93523	316.1	80.5	.001137	.93729	317.9	92.4	.001304				
37	.96406	356.1	459.5	.006488	.96623	354.1	421.5	.005948				
38	.94503	335.4	196.0	.002767	.94909	330.8	188.4	.002659				
39	.94243	327.7	132.5	.001872	.94597	324.6	130.1	.001835				
40	.93916	318.7	98.8	.001396	.94352	320.8	106.4	.001502				
41	.93894	317.2	85.7	.001210	.94293	319.3	93.7	.001323				
42	.93916	315.9	72.8	.001028	.94271	318.0	81.4	.001148				
43	.96079	349.8	371.8	.005250	.96334	348.4	351.1	.004955				
44	.94503	326.8	156.4	.002209	.94909	328.1	160.8	.002269				
45	.94191	319.6	91.2	.001288	.94627	321.4	97.0	.001369				
46	.94058	317.5	80.6	.001138	.94493	319.4	86.1	.001215				
47	.93902	316.5	75.3	.001064	.94352	318.6	82.7	.001167				
48	.95923	346.7	323.8	.004573	.96156	345.5	310.0	.004376				
49	.94325	318.1	72.3	.001021	.94716	320.1	80.0	.001129				
50	.95350	321.0	61.6	.000870	.95302	321.9	69.1	.000975				
51	.95128	320.5	57.8	.000816	.94783	321.5	67.4	.000951				
52	.94073	323.7	141.6	.002000	.94560	325.4	146.2	.002064				
53	.94058	319.9	105.7	.001493	.94545	321.8	111.9	.001579				
54	.94006	318.2	90.1	.001273	.94456	320.1	96.3	.001358				
55	.93879	317.1	80.6	.001139	.94389	319.1	86.9	.001226				
56	.95804	343.0	300.5	.004244	.96015	341.9	286.8	.004047				
57	.94050	322.8	134.6	.001900	.94538	324.6	134.5	.001898				
58	.93931	318.9	97.0	.001369	.94397	320.8	104.4	.001474				
59	.93879	317.4	82.5	.001165	.94323	319.3	88.0	.001241				
60	.95707	341.5	266.4	.003762	.95888	340.5	258.5	.003648				
61	.93337	321.3	137.1	.001936	.93833	322.9	142.8	.002016				
62	.93426	318.0	95.3	.001346	.93826	319.7	101.8	.001437				
63	.94533	320.3	75.6	.001067	.94768	321.7	80.9	.001142				
64	.95038	321.4	65.5	.000924	.95169	323.8	81.3	.001147				
65	.94830	324.6	91.9	.001298	.94864	327.6	138.5	.001954				
66	.94778	337.8	257.1	.003631	.94976	336.6	248.2	.003503				
67	.93285	327.4	201.0	.002839	.93447	326.8	198.6	.002803				
68	.92505	319.3	148.2	.002092	.92631	319.1	147.8	.002085				
69	.93077	311.6	54.1	.000764	.92957	312.3	61.2	.000863				
70	.95061	318.3	46.9	.000663	.94812	320.2	68.3	.000964				
71	.94749	326.0	123.8	.001749	.94412	325.6	142.7	.002015				

[a] h measured in J/m^2-sec-$^\circ$K

TABLE II.- TABULATION OF HEAT-TRANSFER MEASUREMENTS ON CLEAN MODEL AT A NOMINAL REYNOLDS NUMBER BASED ON MODEL LENGTH OF 3.0×10^6 - Continued

(e) $\alpha = -2^o$

Thermocouple	$\beta = 0^o$; $T_w = 392^o$ K; $p_t = 279.0$ kN/m^2											
	$\frac{T_e}{T_t}$	T_w, ^oK	h (a)	N_{St}	$\frac{T_e}{T_t}$	T_w, ^oK	h (a)	N_{St}	$\frac{T_e}{T_t}$	T_w, ^oK	h (a)	N_{St}
1	.98157	368.7	611.3	.008610								
2	.98186	366.7	559.9	.007885								
3	.98042	356.0	426.9	.006013								
4	.97747	350.9	352.2	.004961								
5	.97420	346.1	296.8	.004180								
6	.97458	346.0	280.0	.003944								
7	.96500	342.0	283.2	.003989								
8	.94127	328.6	224.4	.003161								
9	.92615	319.0	140.5	.001979								
10	.93087	307.7	50.8	.000716								
11	.93566	307.4	34.4	.000485								
12	.94097	308.3	29.2	.000411								
13	.96859	361.0	499.0	.007028								
14	.93708	326.1	206.6	.002910								
15	.92667	311.4	67.1	.000945								
16	.92353	303.5	23.7	.000334								
17	.93843	308.3	24.7	.000348								
18	.95354	317.0	51.1	.000720								
19	.95736	317.6	53.4	.000752								
20	.92368	305.2	39.3	.000553								
21	.93147	305.5	25.2	.000354								
22	.94292	307.5	20.3	.000286								
23	.94209	308.0	19.8	.000278								
24	.95452	342.1	343.8	.004842								
25	.93940	326.3	219.5	.003092								
26	.93079	313.6	105.7	.001489								
27	.92593	308.2	66.5	.000937								
28	.92900	308.0	53.6	.000755								
29	.93805	311.8	58.5	.000823								
30	.93858	319.6	54.0	.000761								
31	.96904	360.2	491.8	.006927								
32	.94419	328.5	215.7	.003038								
33	.93596	319.2	108.8	.001532								
34	.93304	312.2	80.5	.001133								
35	.92997	310.5	74.3	.001047								
36	.92944	308.6	60.8	.000857								
37	.96110	347.1	386.8	.005448								
38	.94112	326.7	158.1	.002227								
39	.93790	319.7	106.2	.001496								
40	.93431	311.8	79.0	.001113								
41	.93341	310.4	68.4	.000964								
42	.93304	309.3	57.9	.000816								
43	.95916	341.8	318.0	.004479								
44	.94015	322.9	125.9	.001773								
45	.93693	312.4	72.0	.001013								
46	.93513	310.6	64.1	.000903								
47	.93386	309.9	60.7	.000855								
48	.95759	338.9	278.7	.003926								
49	.93790	311.5	58.4	.000822								
50	.95093	316.1	50.9	.000717								
51	.95033	318.7	71.6	.001009								
52	.93670	320.0	112.7	.001587								
53	.93640	315.6	82.0	.001155								
54	.93521	311.0	69.7	.000981								
55	.93438	310.3	63.8	.000898								
56	.95729	335.8	258.2	.003637								
57	.93640	319.3	108.8	.001533								
58	.93498	314.6	77.3	.001089								
59	.93423	310.5	65.2	.000919								
60	.95706	334.8	232.1	.003269								
61	.93042	314.3	112.8	.001588								
62	.93064	311.0	76.1	.001071								
63	.93805	312.2	61.6	.000867								
64	.95145	315.8	42.5	.000599								
65	.95010	317.7	61.5	.000866								
66	.94868	331.8	228.4	.003217								
67	.93446	322.2	179.5	.002528								
68	.92712	314.9	131.2	.001848								
69	.93117	307.1	42.3	.000596								
70	.93895	308.1	32.5	.000457								
71	.94905	312.0	26.7	.000376								

[a] h measured in J/m^2-sec-^{o}K

TABLE II.- TABULATION OF HEAT-TRANSFER MEASUREMENTS ON CLEAN MODEL AT A NOMINAL REYNOLDS NUMBER BASED ON MODEL LENGTH OF 3.0×10^6 - Continued

(f) $\alpha = 0^o$

Thermo-couple	$\beta = -10^o$; $T_w = 389^o$ K; $p_t = 279.0$ kN/m^2				$\beta = -5^o$; $T_w = 390^o$ K; $p_t = 279.9$ kN/m^2				$\beta = 0^o$; $T_w = 391^o$ K; $p_t = 279.0$ kN/m^2			
	$\frac{T_e}{T_t}$	T_w, ^oK	h (a)	N_{St}	$\frac{T_e}{T_t}$	T_w, ^oK	h (a)	N_{St}	$\frac{T_e}{T_t}$	T_w, ^oK	h (a)	N_{St}
1	.98266	359.3	485.1	.006806	.98148	364.3	425.0	.005552	.98078	371.6	537.3	.007561
2	.98454	357.7	461.6	.006476	.98344	363.5	423.5	.005930	.98250	370.8	519.2	.007305
3	.98266	353.4	386.7	.005425	.98177	359.8	357.7	.005009	.98150	374.0	399.4	.005620
4	.98020	348.4	319.7	.004486	.97885	354.9	307.7	.004309	.97856	356.6	348.9	.004909
5	.97765	344.0	273.0	.003831	.97637	350.2	265.8	.003722	.97620	351.8	295.6	.004159
6	.97817	343.9	257.4	.003611	.97712	350.1	249.6	.003495	.97684	351.7	278.5	.003918
7	.96788	339.8	263.3	.003694	.96674	345.9	253.9	.003556	.96715	347.3	279.2	.003928
8	.94527	327.4	212.4	.002979	.94388	332.6	209.6	.002936	.94404	334.1	226.8	.003191
9	.93115	319.3	131.6	.001847	.92899	318.2	139.5	.001953	.92928	319.7	145.3	.002044
10	.93182	307.0	52.2	.000732	.93095	308.8	54.2	.000759	.93449	311.6	55.2	.000776
11	.94046	310.8	44.8	.000629	.93403	307.5	38.5	.000539	.94038	311.5	39.5	.000555
12	.95338	321.8	114.4	.001604	.94599	312.3	34.4	.000482	.94635	312.6	34.7	.000488
13	.96773	350.3	396.1	.005557	.96674	355.6	353.8	.004954	.96693	368.5	382.7	.005385
14	.93671	321.9	178.4	.002502	.93486	327.1	182.7	.002558	.93509	328.4	195.3	.002749
15	.92657	308.9	55.1	.000773	.92456	310.7	63.7	.000892	.92517	309.4	58.8	.000828
16	.92446	303.2	23.8	.000334	.92177	302.7	23.1	.000323	.92324	303.5	21.2	.000298
17	.94009	308.8	35.3	.000495	.93930	308.8	32.2	.000452	.94501	311.6	29.9	.000420
18	.92769	309.4	70.3	.000987	.93591	312.0	54.0	.000757	.95470	317.2	37.1	.000523
19	.92957	309.4	67.3	.000945	.93095	312.6	71.8	.001005	.95753	319.2	47.1	.000663
20	.92544	302.8	25.6	.000360	.92237	303.0	29.8	.000417	.92294	304.5	33.7	.000475
21	.93573	304.2	17.1	.000240	.93200	304.3	21.1	.000295	.93502	307.6	22.7	.000319
22	.94474	310.7	28.1	.000394	.94050	308.2	27.4	.000383	.94523	309.5	19.9	.000280
23	.94429	308.8	33.9	.000476	.94253	308.2	23.5	.000329	.94635	309.4	16.7	.000235
24	.94843	333.2	269.2	.003776	.95028	341.2	277.4	.003884	.95306	350.9	336.4	.004734
25	.93483	324.0	164.6	.002309	.93554	325.3	183.1	.002564	.93792	328.9	209.7	.002951
26	.92747	309.4	64.0	.000898	.92689	310.6	83.0	.001162	.92950	315.3	99.8	.001405
27	.92567	306.4	36.9	.000517	.92328	305.3	47.7	.000669	.92406	309.2	61.8	.000869
28	.93213	304.8	23.5	.000330	.92741	305.2	36.6	.000513	.92950	309.6	49.1	.000691
29	.94227	307.9	29.6	.000416	.93606	308.5	38.2	.000535	.93964	312.9	47.8	.000673
30	.94505	309.7	34.4	.000483	.93869	309.6	39.0	.000546	.93986	315.5	52.1	.000733
31	.96232	344.8	354.1	.004968	.96479	353.1	346.1	.004847	.96857	363.3	440.2	.006195
32	.93633	324.0	151.7	.002128	.93922	326.8	178.5	.002499	.94381	332.2	212.6	.002992
33	.92942	310.5	65.9	.000925	.93095	316.0	86.8	.001215	.93569	318.1	107.6	.001514
34	.92702	307.6	50.1	.000702	.92779	309.1	62.9	.000881	.93218	314.5	79.9	.001124
35	.92409	303.6	43.9	.000616	.92388	306.8	55.9	.000783	.92875	312.5	73.5	.001035
36	.92446	303.7	31.5	.000442	.92358	305.1	45.1	.000632	.92816	310.6	61.0	.000858
37	.95406	337.8	298.3	.004184	.95734	347.2	311.2	.004358	.96126	357.7	393.0	.005529
38	.93228	316.0	99.1	.001390	.93516	319.2	134.8	.001887	.94098	325.0	159.5	.002244
39	.92852	309.9	63.2	.000887	.93140	316.2	88.0	.001233	.93770	318.7	104.1	.001465
40	.92559	306.3	47.3	.000663	.92749	308.4	63.3	.000887	.93420	314.4	79.9	.001125
41	.92491	304.8	38.8	.000544	.92659	306.7	53.3	.000747	.93308	312.8	69.3	.000976
42	.92469	303.7	31.4	.000441	.92606	305.6	46.0	.000644	.93278	311.5	59.0	.000830
43	.95060	331.9	244.7	.003434	.95426	341.4	261.1	.003656	.95977	346.8	313.5	.004412
44	.92995	312.4	76.4	.001072	.93396	319.7	105.1	.001472	.94046	321.8	127.2	.001789
45	.92664	303.9	35.8	.000503	.93027	311.1	55.9	.000783	.93748	315.1	73.2	.001030
46	.92484	304.2	34.5	.000484	.92809	306.9	50.9	.000712	.93569	313.1	64.3	.000905
47	.92326	303.6	33.7	.000473	.92583	305.9	47.7	.000668	.93397	312.2	60.8	.000855
48	.94948	329.3	214.2	.003005	.95306	338.6	231.2	.003238	.95858	344.0	277.3	.003902
49	.92777	303.9	35.8	.000503	.92952	307.3	45.6	.000638	.93867	314.0	58.2	.000819
50	.93776	305.8	25.6	.000359	.93802	308.4	35.1	.000492	.94970	316.7	45.1	.000634
51	.94805	308.8	15.3	.000214	.94779	311.3	25.3	.000355	.95261	318.3	41.8	.000588
52	.92567	309.8	69.1	.000969	.92937	316.5	94.6	.001324	.93725	319.1	114.0	.001605
53	.92476	303.8	42.5	.000597	.92877	311.4	64.8	.000908	.93695	315.2	79.6	.001120
54	.92386	304.4	38.8	.000544	.92779	307.2	55.7	.000780	.93599	313.6	70.2	.000988
55	.92326	304.1	37.6	.000528	.92659	306.5	50.7	.000710	.93502	312.9	64.2	.000903
56	.94993	327.0	200.1	.002807	.95351	335.8	221.7	.003105	.95887	341.0	259.6	.003652
57	.92521	309.3	67.5	.000947	.92959	316.0	91.9	.001287	.93748	318.8	110.3	.001552
58	.92259	305.4	47.0	.000659	.92726	308.2	63.3	.000887	.93591	314.5	77.2	.001086
59	.92251	304.2	39.1	.000549	.92674	306.5	51.1	.000716	.93494	313.0	64.9	.000914
60	.94970	326.4	182.5	.002560	.95366	335.0	199.6	.002795	.95880	339.9	233.1	.003280
61	.91943	308.0	72.5	.001017	.92403	311.3	93.4	.001308	.93159	317.6	112.5	.001582
62	.91943	302.6	47.9	.000673	.92350	307.5	61.0	.000854	.93129	313.6	75.4	.001061
63	.92582	303.3	27.1	.000381	.92952	306.7	42.8	.000599	.93800	313.7	58.2	.000819
64	.93483	305.6	18.4	.000258	.93396	306.2	28.7	.000402	.94575	314.4	40.9	.000575
65	.94760	313.5	54.3	.000761	.94238	308.4	20.8	.000291	.95395	316.7	32.1	.000452
66	.94189	323.7	182.0	.002554	.94546	331.8	194.8	.002728	.95060	336.7	226.0	.003181
67	.92920	315.0	138.6	.001944	.93185	322.2	156.9	.002197	.93666	326.8	179.3	.002522
68	.92259	312.6	98.0	.001374	.92486	314.7	118.1	.001654	.92980	319.4	134.9	.001898
69	.92567	304.9	34.8	.000488	.92719	305.4	38.7	.000542	.93367	310.5	46.3	.000651
70	.93243	305.2	27.9	.000392	.93140	305.1	30.5	.000427	.93971	310.4	35.2	.000495
71	.95075	317.2	78.4	.001100	.94764	312.4	29.0	.000406	.94709	311.8	28.7	.000404

[a] h measured in J/m^2-sec-^{o}K

TABLE II.- TABULATION OF HEAT-TRANSFER MEASUREMENTS ON CLEAN MODEL AT A NOMINAL REYNOLDS NUMBER BASED ON MODEL LENGTH OF 3.0×10^6 - Continued

(f) $\alpha = 0^o$ - Concluded

Thermocouple	$\beta = 0^o$; $T_w = 388^o$ K; $p_t = 308.0$ kN/m^2				$\beta = 5^o$; $T_w = 391^o$ K; $p_t = 279.5$ kN/m^2				$\beta = 10^o$; $T_w = 389^o$ K; $p_t = 277.7$ kN/m^2			
	$\frac{T_e}{T_t}$	T_w, ^{o}K	h (a)	N_{St}	$\frac{T_e}{T_t}$	T_w, ^{o}K	h (a)	N_{St}	$\frac{T_e}{T_t}$	T_w, ^{o}K	h (a)	N_{St}
1	.98248	376.3	658.6	.008355	.97602	359.3	556.4	.007609	.97523	358.7	415.0	.005850
2	.98463	376.4	614.0	.007789	.97767	357.9	526.3	.007386	.97749	357.6	407.4	.005742
3	.98348	363.0	557.1	.007067	.97688	354.3	441.9	.006201	.97663	354.6	356.3	.005022
4	.98054	358.1	451.8	.005731	.97459	349.4	361.8	.005078	.97411	349.9	302.6	.004265
5	.97774	353.3	371.3	.004710	.97175	344.9	304.9	.004278	.97149	345.4	257.9	.003635
6	.97838	353.3	349.1	.004428	.97242	345.0	289.3	.004060	.97239	345.4	242.9	.003424
7	.96875	349.0	347.6	.004409	.96271	341.1	294.0	.004125	.96282	341.3	243.8	.003436
8	.94486	335.8	278.0	.003527	.93994	328.3	234.7	.003293	.94008	328.8	199.7	.002815
9	.92873	321.2	178.3	.002261	.92494	319.7	146.0	.002050	.92558	315.7	132.0	.001860
10	.92768	310.9	66.9	.000849	.92770	307.7	54.9	.000770	.92617	307.1	50.2	.000707
11	.93030	309.8	48.9	.000620	.93188	307.5	40.4	.000566	.93784	311.9	44.7	.000631
12	.93276	309.7	43.6	.000553	.94032	310.9	37.7	.000528	.94823	323.0	111.6	.001573
13	.96801	369.0	502.7	.006376	.96249	351.2	453.8	.006369	.96267	351.0	349.3	.004923
14	.93425	329.8	239.5	.003038	.93106	328.7	201.7	.002831	.93141	323.7	175.8	.002478
15	.92186	313.4	81.2	.001029	.92053	308.9	59.8	.000840	.92079	306.7	55.4	.000781
16	.91648	304.2	29.1	.000369	.91784	302.0	21.6	.000303	.91683	300.8	20.8	.000293
17	.93545	310.3	38.5	.000489	.93725	308.9	33.2	.000466	.93410	308.0	30.1	.000424
18	.94426	316.2	51.4	.000652	.93845	313.9	50.7	.000712	.92737	311.4	65.2	.000919
19	.94949	319.2	67.7	.000859	.93098	311.6	72.4	.001017	.92468	310.1	64.7	.000911
20	.91648	305.5	44.4	.000563	.91695	301.7	34.9	.000490	.91556	302.1	39.7	.000560
21	.92469	306.0	31.0	.000393	.92516	302.8	22.0	.000308	.92034	303.5	29.4	.000415
22	.92962	307.4	31.0	.000393	.93292	304.8	18.2	.000255	.92460	303.0	26.7	.000377
23	.93291	307.9	26.2	.000333	.93487	305.9	17.4	.000244	.91645	300.6	26.9	.000379
24	.95382	359.3	371.9	.004718	.95189	341.0	358.7	.005033	.95571	344.0	309.9	.004369
25	.93746	330.4	255.2	.003237	.93636	331.6	231.5	.003250	.94008	329.0	215.7	.003040
26	.92723	316.1	121.2	.001538	.92740	317.6	117.4	.001648	.93096	317.3	121.7	.001716
27	.91947	309.2	74.3	.000942	.92053	307.7	76.8	.001078	.92363	311.0	84.7	.001194
28	.92156	308.5	59.8	.000758	.92396	307.8	63.5	.000891	.92558	310.3	70.5	.000994
29	.92843	311.2	60.6	.000769	.93009	310.2	65.8	.000924	.92984	311.7	68.2	.000962
30	.93231	312.3	55.7	.000707	.93039	310.6	65.6	.000920	.92161	310.6	75.9	.001069
31	.96980	369.4	509.3	.006461	.96772	353.8	486.3	.006825	.97224	356.5	391.1	.005513
32	.94321	333.7	262.2	.003327	.94442	336.7	245.1	.003440	.95055	335.5	235.1	.003314
33	.93388	319.3	131.9	.001674	.93613	321.8	125.2	.001758	.94300	322.5	134.4	.001895
34	.92910	315.1	97.0	.001231	.93270	314.2	97.4	.001367	.93964	319.2	105.8	.001491
35	.92514	312.8	88.2	.001119	.92919	312.6	92.9	.001303	.93590	317.4	100.3	.001414
36	.92320	310.6	73.9	.000937	.92815	310.5	77.3	.001085	.93425	314.9	85.4	.001203
37	.96263	353.2	483.7	.006135	.96189	348.4	425.2	.005968	.96820	353.0	365.9	.005157
38	.94023	326.7	196.7	.002495	.94278	329.8	177.0	.002483	.94988	329.7	178.9	.002521
39	.93619	319.9	133.6	.001694	.93964	322.8	122.5	.001719	.94674	323.6	127.3	.001794
40	.93149	315.3	97.8	.001241	.93591	318.0	96.2	.001350	.94360	319.4	104.1	.001467
41	.92925	313.2	84.3	.001070	.93501	316.1	85.4	.001158	.94263	317.8	92.4	.001303
42	.92820	311.6	72.6	.000921	.93427	314.6	74.5	.001045	.94188	316.4	80.8	.001139
43	.96061	348.2	397.7	.005045	.96070	343.8	355.5	.004989	.96633	348.2	319.6	.004505
44	.93926	323.2	156.1	.001980	.94278	326.5	143.9	.002019	.95085	332.6	151.6	.002136
45	.93463	315.9	88.0	.001117	.93964	318.8	87.0	.001222	.94779	320.3	89.3	.001258
46	.93186	313.6	78.2	.000991	.93785	316.4	77.8	.001092	.94614	318.1	84.2	.001186
47	.92925	312.4	74.4	.000944	.93621	312.7	74.9	.001051	.94427	317.3	81.3	.001146
48	.95957	345.6	347.9	.004414	.95965	341.1	311.7	.004375	.96543	345.6	285.7	.004027
49	.93358	314.3	72.6	.000921	.93964	314.3	73.2	.001027	.94771	318.5	77.2	.001088
50	.94784	317.7	51.0	.000647	.95122	317.7	54.8	.000770	.95639	320.4	59.9	.000844
51	.94740	323.0	78.3	.000994	.95017	318.9	63.9	.000897	.95429	325.6	61.8	.000871
52	.93590	320.5	139.7	.001772	.93979	323.6	129.4	.001815	.94801	324.5	131.4	.001852
53	.93440	316.1	101.6	.001288	.93949	315.6	90.8	.001275	.94801	320.7	99.9	.001408
54	.93298	314.3	85.7	.001087	.93860	317.3	85.6	.001201	.94681	319.0	91.9	.001295
55	.93067	313.3	78.5	.000996	.93755	313.3	77.4	.001087	.94539	317.8	83.5	.001177
56	.95987	342.7	322.6	.004093	.95973	344.9	292.4	.004104	.96536	342.5	267.6	.003772
57	.93590	320.0	135.7	.001722	.94032	323.1	125.1	.001756	.94906	324.1	127.2	.001793
58	.93298	315.2	94.1	.001193	.93890	318.3	91.2	.001279	.94711	319.9	98.4	.001386
59	.93149	313.5	78.3	.000993	.93740	313.5	78.6	.001104	.94547	318.1	84.8	.001195
60	.95979	341.6	287.3	.003644	.95973	337.2	259.5	.003642	.96536	341.4	240.1	.003384
61	.92977	318.6	136.3	.001729	.93427	317.6	132.1	.001854	.94203	322.5	134.8	.001900
62	.92828	314.2	90.1	.001143	.93330	313.5	89.3	.001253	.94068	318.0	94.0	.001325
63	.93351	313.7	69.0	.000875	.93845	313.6	71.5	.001003	.94502	317.4	76.4	.001077
64	.94687	316.2	43.4	.000550	.94905	316.2	49.9	.000700	.95145	318.0	61.7	.000870
65	.94769	317.1	42.3	.000537	.95159	317.7	48.1	.000675	.95676	326.0	58.0	.000818
66	.95113	338.2	278.1	.003528	.95107	334.0	255.7	.003588	.95639	337.8	232.5	.003277
67	.93664	328.3	217.3	.002757	.93681	324.6	202.8	.002846	.94203	328.5	190.9	.002691
68	.92865	320.7	164.9	.002091	.92956	322.4	151.2	.002123	.93440	321.3	148.8	.002097
69	.92679	309.8	57.1	.000724	.93113	309.1	53.9	.000756	.93485	312.1	61.9	.000873
70	.93112	309.0	43.2	.000547	.93927	311.1	50.4	.000707	.95145	318.5	58.4	.000823
71	.93366	309.1	36.0	.000457	.95278	317.6	43.7	.000613	.95369	327.8	126.0	.001776

[a] h measured in J/m^2-sec-^{o}K

TABLE II.- TABULATION OF HEAT-TRANSFER MEASUREMENTS ON CLEAN MODEL AT A NOMINAL REYNOLDS NUMBER BASED ON MODEL LENGTH OF 3.0×10^6 - Continued

(g) $\alpha = 2^\circ$

Thermocouple	$\beta = 0^\circ$; $T_w = 389^\circ$ K; $p_t = 275.6$ kN/m^2											
	$\frac{T_e}{T_t}$	T_w, $^\circ$K	h (a)	N_{St}	$\frac{T_e}{T_t}$	T_w, $^\circ$K	h (a)	N_{St}	$\frac{T_e}{T_t}$	T_w, $^\circ$K	h (a)	N_{St}
1	.98032	370.5	490.5	.006967								
2	.98346	370.6	493.4	.007008								
3	.98260	367.9	437.5	.006213								
4	.98032	363.0	367.4	.005219								
5	.97833	358.3	311.1	.004418								
6	.97904	358.3	291.3	.004137								
7	.96963	353.9	291.8	.004145								
8	.94747	341.1	241.9	.003436								
9	.93213	326.7	163.5	.002322								
10	.93324	315.6	63.8	.000906								
11	.93643	314.8	48.9	.000695								
12	.94051	315.4	44.3	.000629								
13	.96519	361.4	407.7	.005791								
14	.93265	332.0	196.6	.002793								
15	.92227	314.7	68.6	.000974								
16	.92064	306.9	25.1	.000357								
17	.94095	314.5	39.5	.000560								
18	.93784	314.4	40.4	.000574								
19	.94392	318.0	45.9	.000652								
20	.91916	307.0	35.5	.000504								
21	.92909	309.0	29.0	.000412								
22	.93250	309.5	26.0	.000369								
23	.93369	310.1	21.1	.000300								
24	.95133	349.3	311.4	.004423								
25	.93561	333.0	214.2	.003042								
26	.92687	318.1	103.9	.001475								
27	.91975	310.6	60.8	.000863								
28	.92257	310.2	48.5	.000688								
29	.92731	311.5	46.5	.000660								
30	.92701	310.7	39.9	.000567								
31	.96778	362.3	409.0	.005809								
32	.94258	337.4	225.3	.003201								
33	.93354	322.2	117.5	.001669								
34	.92924	317.6	84.6	.001202								
35	.92612	315.2	75.1	.001067								
36	.92405	312.8	63.1	.000897								
37	.96297	358.1	376.5	.005347								
38	.94021	330.4	177.7	.002524								
39	.93665	323.3	121.8	.001730								
40	.93280	318.2	86.6	.001229								
41	.93131	316.0	73.9	.001050								
42	.92998	314.4	63.9	.000907								
43	.96074	353.0	329.6	.004681								
44	.94006	326.9	142.0	.002017								
45	.93606	318.7	79.5	.001129								
46	.93428	316.5	69.7	.000989								
47	.93235	315.4	66.0	.000938								
48	.95978	350.3	293.5	.004169								
49	.93398	315.6	60.5	.000860								
50	.93621	313.6	45.4	.000645								
51	.93902	313.5	36.6	.000520								
52	.93784	328.2	126.2	.001793								
53	.93636	322.4	91.3	.001297								
54	.93547	317.4	76.8	.001090								
55	.93391	316.3	68.2	.000968								
56	.96037	347.5	279.4	.003968								
57	.93769	323.5	122.5	.001740								
58	.93487	318.2	84.8	.001204								
59	.93383	316.2	69.2	.000983								
60	.96037	346.3	248.1	.003524								
61	.93198	322.0	119.7	.001700								
62	.93042	316.8	78.3	.001113								
63	.93309	314.8	57.9	.000823								
64	.93428	312.8	43.1	.000612								
65	.93843	312.9	34.2	.000485								
66	.95237	342.7	239.2	.003398								
67	.93917	333.0	192.5	.002735								
68	.93146	325.2	150.1	.002132								
69	.93176	314.0	53.9	.000766								
70	.93450	312.9	44.2	.000627								
71	.93902	313.5	37.4	.000531								

[a] h measured in J/m^2-sec-$^\circ$K

TABLE II.- TABULATION OF HEAT-TRANSFER MEASUREMENTS ON CLEAN MODEL AT A NOMINAL REYNOLDS NUMBER BASED ON MODEL LENGTH OF 3.0×10^6 - Continued

(h) $\alpha = 5^\circ$

Thermocouple	$\beta = -10^\circ$; $T_w = 391^\circ$ K; $p_t = 278.0$ kN/m^2				$\beta = -5^\circ$; $T_w = 388^\circ$ K; $p_t = 277.6$ kN/m^2				$\beta = 0^\circ$; $T_w = 389^\circ$ K; $p_t = 277.8$ kN/m^2			
	$\frac{T_e}{T_t}$	T_w, $^\circ$K	h (a)	N_{St}	$\frac{T_e}{T_t}$	T_w, $^\circ$K	h (a)	N_{St}	$\frac{T_e}{T_t}$	T_w, $^\circ$K	h (a)	N_{St}
1	.98193	361.7	423.4	.005974	.98076	370.7	501.1	.007042	.97859	368.5	514.1	.007245
2	.98812	369.3	418.1	.005900	.98682	373.0	519.4	.007299	.98412	370.3	527.9	.007439
3	.98834	361.3	383.2	.005408	.98703	371.2	459.9	.006463	.98426	361.9	448.7	.006324
4	.98704	356.5	310.6	.004383	.98552	362.3	373.8	.005253	.98267	356.7	370.7	.005224
5	.98582	352.2	266.4	.003760	.98415	357.8	316.9	.004454	.98138	352.1	313.0	.004411
6	.98639	352.1	251.0	.003542	.98494	357.7	296.4	.004165	.98181	352.2	297.2	.004188
7	.97754	347.9	252.7	.003566	.97557	353.3	299.0	.004202	.97259	348.1	302.2	.004258
8	.95689	336.6	215.4	.003039	.95474	341.4	253.5	.003562	.95202	336.3	253.1	.003566
9	.94311	324.2	150.8	.002129	.94074	327.8	176.9	.002486	.93738	322.9	172.2	.002426
10	.94439	315.1	64.9	.000915	.94261	316.9	73.5	.001033	.93926	313.5	73.4	.001035
11	.94865	315.6	54.2	.000765	.94785	317.0	59.4	.000835	.94406	313.6	59.8	.000843
12	.96348	324.1	63.5	.000895	.95182	317.7	55.6	.000782	.94827	314.4	56.5	.000797
13	.96632	352.2	344.0	.004855	.96448	361.0	388.1	.005454	.96178	358.0	400.4	.005642
14	.93518	323.4	156.4	.002206	.93264	327.0	181.5	.002550	.93010	321.8	174.6	.002460
15	.92529	306.4	44.2	.000624	.92298	307.4	55.3	.000777	.92049	304.0	46.0	.000649
16	.92470	302.5	18.2	.000257	.92313	303.7	27.7	.000389	.92199	302.2	27.1	.000382
17	.94573	312.4	38.2	.000539	.94486	318.6	53.5	.000752	.94286	311.0	45.6	.000642
18	.92814	307.1	44.9	.000634	.93886	317.7	58.3	.000819	.93731	309.7	42.6	.000600
19	.92627	304.9	35.4	.000499	.93796	316.5	57.2	.000804	.94421	312.2	44.8	.000631
20	.92110	304.9	32.0	.000452	.91991	302.1	32.6	.000459	.91899	300.1	26.7	.000376
21	.93054	305.8	21.5	.000303	.93137	304.6	23.9	.000336	.93250	308.1	31.9	.000449
22	.93967	307.6	18.1	.000255	.93841	306.0	20.1	.000282	.93145	303.1	20.3	.000286
23	.94484	306.5	12.0	.000169	.94456	306.9	14.9	.000210	.93333	303.3	18.3	.000257
24	.95973	350.6	292.2	.004123	.95444	351.8	324.4	.004559	.94842	345.7	311.9	.004396
25	.94401	329.4	197.7	.002790	.93894	330.9	214.6	.003016	.93340	323.2	193.6	.002729
26	.93458	317.2	109.5	.001546	.92935	316.7	111.2	.001563	.92485	310.3	91.4	.001289
27	.92604	310.0	71.6	.001010	.92096	308.7	66.9	.000940	.91749	303.6	53.5	.000754
28	.92919	309.5	58.5	.000826	.92530	308.3	53.5	.000752	.92245	303.8	42.7	.000602
29	.93383	310.0	51.5	.000727	.93077	309.2	47.0	.000661	.92470	303.9	37.8	.000533
30	.93450	309.0	44.2	.000623	.93152	307.9	39.4	.000554	.92425	302.6	31.5	.000444
31	.97869	359.5	400.2	.005647	.97287	365.7	437.1	.006143	.96568	360.1	428.9	.006045
32	.95704	338.3	229.7	.003241	.94942	338.6	244.0	.003428	.94151	328.6	212.1	.002989
33	.94925	325.0	132.5	.001870	.94096	323.7	134.2	.001886	.93265	315.2	110.2	.001553
34	.94491	321.0	102.7	.001449	.93632	318.9	98.2	.001380	.92815	311.2	81.7	.001152
35	.94117	318.8	95.0	.001341	.93212	316.3	89.3	.001254	.92470	309.1	74.5	.001050
36	.93952	316.6	82.7	.001167	.93062	313.9	76.2	.001070	.92335	307.0	61.6	.000867
37	.97568	362.7	368.8	.005205	.96883	363.0	419.2	.005891	.96268	356.8	389.4	.005488
38	.95779	333.4	188.1	.002654	.94920	332.8	200.8	.002822	.94001	322.8	165.2	.002328
39	.95502	327.0	135.5	.001912	.94568	325.5	141.3	.001986	.93686	316.6	106.3	.001497
40	.95135	322.4	104.5	.001475	.94178	320.2	103.8	.001458	.93295	312.4	83.3	.001174
41	.95038	320.5	92.1	.001299	.94036	318.0	89.9	.001263	.93153	310.4	71.6	.001010
42	.94955	319.4	82.1	.001158	.93961	316.6	77.8	.001094	.93040	309.2	63.4	.000893
43	.97635	353.7	324.7	.004582	.96905	355.4	359.5	.005051	.96133	346.2	333.3	.004697
44	.95958	330.8	155.0	.002187	.95017	329.7	163.1	.002291	.94076	320.1	133.5	.001882
45	.95659	323.5	94.2	.001330	.94673	321.3	94.8	.001331	.93708	313.0	75.7	.001066
46	.95487	321.3	84.9	.001198	.94471	318.8	84.3	.001185	.93528	311.2	68.1	.000959
47	.95255	320.1	81.6	.001151	.94246	317.5	79.4	.001115	.93310	310.2	65.8	.000927
48	.97650	351.2	291.1	.004108	.96935	352.8	320.5	.004503	.96118	343.6	296.1	.004172
49	.95434	319.7	71.4	.001007	.94486	317.1	69.0	.000969	.93476	309.9	57.1	.000804
50	.95554	317.3	54.0	.000762	.94755	314.9	50.8	.000714	.93641	307.9	40.5	.000571
51	.95884	317.9	47.4	.000670	.95062	314.7	41.8	.000588	.93881	307.4	30.9	.000435
52	.95809	328.4	140.0	.001975	.94823	327.1	147.3	.002071	.93896	318.1	121.0	.001705
53	.95764	332.1	107.1	.001511	.94740	322.0	109.2	.001534	.93746	313.8	84.0	.001183
54	.95636	322.3	92.4	.001304	.94605	319.8	92.0	.001293	.93656	312.0	74.2	.001046
55	.95464	320.8	82.7	.001167	.94418	318.2	80.9	.001137	.93476	310.8	67.2	.000948
56	.97761	348.3	274.1	.003868	.97062	350.0	304.1	.004274	.96268	340.9	277.0	.003904
57	.95869	327.7	133.4	.001892	.94875	326.5	140.9	.001981	.93896	317.6	117.7	.001659
58	.95659	323.0	97.3	.001373	.94620	320.8	99.2	.001393	.93596	312.8	82.1	.001157
59	.95487	320.9	82.4	.001163	.94441	318.4	82.9	.001165	.93476	311.0	67.8	.000955
60	.97725	346.8	244.2	.003446	.97047	348.6	270.4	.003800	.96238	339.8	248.8	.003505
61	.95217	325.8	131.8	.001860	.94261	324.5	136.8	.001922	.93370	316.1	115.1	.001622
62	.95120	320.4	87.1	.001229	.94163	318.3	87.8	.001233	.93220	311.0	73.3	.001033
63	.95464	319.5	70.8	.001000	.94516	316.7	66.2	.000930	.93491	309.1	52.1	.000734
64	.95749	318.5	57.6	.000613	.94800	315.2	50.9	.000715	.93611	307.2	36.3	.000512
65	.96153	319.0	49.6	.000699	.95265	315.3	41.3	.000580	.94346	309.6	31.9	.000449
66	.96917	343.3	237.8	.003355	.96253	345.0	260.7	.003663	.95457	336.6	242.1	.003412
67	.95681	334.8	198.2	.002797	.94972	335.8	215.5	.003029	.94241	327.6	195.0	.002748
68	.94970	327.9	157.8	.002227	.94283	328.4	169.9	.002388	.93581	320.8	152.8	.002153
69	.95067	318.4	68.6	.000968	.94373	317.3	69.3	.000974	.93656	311.4	62.1	.000875
70	.95696	319.2	63.3	.000893	.95055	317.6	61.1	.000658	.94061	310.9	51.8	.000730
71	.96078	320.0	57.9	.000817	.95422	318.2	54.2	.000762	.94609	312.4	45.6	.000642

[a] h measured in J/m^2-sec-$^\circ$K

TABLE II.- TABULATION OF HEAT-TRANSFER MEASUREMENTS ON CLEAN MODEL AT A NOMINAL REYNOLDS NUMBER BASED ON MODEL LENGTH OF 3.0×10^6 - Continued

(h) $\alpha = 5^\circ$ - Concluded

Thermocouple	$\beta = 5^\circ$; $T_w = 388^\circ$ K; $p_t = 277.4$ kN/m^2				$\beta = 10^\circ$; $T_w = 387^\circ$ K; $p_t = 277.1$ kN/m^2							
	$\frac{T_e}{T_t}$	T_w, $^\circ$K	h (a)	N_{St}	$\frac{T_e}{T_t}$	T_w, $^\circ$K	h (a)	N_{St}	$\frac{T_e}{T_t}$	T_w, $^\circ$K	h (a)	N_{St}
1	.97646	364.8	488.3	.006876	.97741	358.8	416.6	.005863				
2	.98226	366.1	493.3	.006946	.98349	360.0	422.7	.005949				
3	.98204	363.6	436.5	.006146	.98298	357.7	381.8	.005374				
4	.98061	358.7	362.8	.005108	.98155	353.2	325.2	.004577				
5	.97947	354.3	308.4	.004343	.97997	348.9	280.3	.003945				
6	.97961	354.2	292.0	.004112	.98020	348.8	263.8	.003713				
7	.97073	350.2	295.4	.004160	.97086	344.8	268.3	.003776				
8	.95020	338.6	249.4	.003513	.95075	333.7	230.2	.003240				
9	.93607	325.4	170.4	.002400	.93712	321.3	162.6	.002288				
10	.93711	315.9	73.5	.001036	.93764	311.8	70.2	.000987				
11	.94113	315.6	59.6	.000839	.94276	312.7	58.2	.000819				
12	.94514	316.5	56.3	.000792	.95670	320.1	66.1	.000931				
13	.95950	354.0	378.4	.005328	.96024	348.2	326.7	.004599				
14	.92833	324.1	173.3	.002440	.92898	319.8	164.4	.002314				
15	.91881	308.9	51.8	.000729	.91957	305.5	51.1	.000719				
16	.91925	305.4	26.5	.000373	.91919	301.3	23.7	.000333				
17	.93904	315.7	55.9	.000787	.93938	309.5	42.7	.000601				
18	.92759	312.8	59.3	.000836	.91874	303.1	45.6	.000642				
19	.92788	311.7	55.0	.000774	.91964	301.3	35.3	.000497				
20	.91866	304.2	28.6	.000402	.92107	301.7	29.1	.000409				
21	.93636	311.0	40.3	.000568	.93938	309.0	40.7	.000573				
22	.93279	308.6	32.9	.000464	.94322	309.3	39.4	.000555				
23	.93101	307.6	27.8	.000391	.94630	310.2	35.7	.000502				
24	.94410	339.5	279.8	.003940	.94179	332.1	241.2	.003395				
25	.92952	323.3	177.9	.002505	.92853	317.0	156.9	.002208				
26	.92163	313.3	77.1	.001086	.92160	307.4	63.6	.000896				
27	.91628	304.4	42.6	.000600	.91912	301.7	32.8	.000462				
28	.92535	309.4	35.7	.000502	.93237	305.2	29.0	.000409				
29	.92669	308.6	29.8	.000419	.94013	305.8	23.5	.000331				
30	.92446	304.3	23.6	.000333	.94367	307.1	20.3	.000285				
31	.96017	353.4	380.6	.005360	.95730	344.9	315.5	.004455				
32	.93532	327.3	187.3	.002637	.93207	319.2	158.3	.002229				
33	.92669	317.4	91.4	.001287	.92446	310.1	73.8	.001039				
34	.92238	310.0	66.2	.000933	.92107	303.9	48.9	.000688				
35	.91881	308.0	59.0	.000831	.91829	302.1	44.0	.000620				
36	.91821	306.3	48.5	.000683	.91957	302.8	35.8	.000504				
37	.95556	349.1	346.0	.004872	.95075	339.6	288.8	.004064				
38	.93250	325.6	142.6	.002008	.92898	317.3	118.8	.001673				
39	.92937	318.3	92.3	.001300	.92552	310.1	74.2	.001044				
40	.92491	310.6	68.5	.000965	.92168	305.6	51.3	.000723				
41	.92372	308.9	58.6	.000825	.92070	302.4	44.2	.000622				
42	.92312	308.0	51.8	.000729	.92107	302.2	37.9	.000534				
43	.95407	344.3	301.4	.004244	.94992	335.6	252.2	.003550				
44	.93264	322.3	113.3	.001595	.92800	313.8	92.6	.001304				
45	.92848	313.6	60.4	.000850	.92431	306.0	46.5	.000654				
46	.92684	309.6	55.5	.000781	.92228	304.3	41.0	.000577				
47	.92446	308.8	53.8	.000758	.92077	303.7	40.3	.000567				
48	.95422	342.0	267.2	.003763	.95015	333.5	225.5	.003174				
49	.92640	308.5	45.3	.000638	.92461	302.5	34.1	.000480				
50	.92907	306.7	29.0	.000409	.93569	303.5	18.4	.000260				
51	.93815	308.8	22.8	.000321	.94796	313.9	52.5	.000739				
52	.92997	319.8	102.5	.001443	.92484	311.5	84.5	.001189				
53	.92840	314.8	72.7	.001024	.92333	307.0	57.5	.000809				
54	.92729	312.5	60.4	.000851	.92190	305.0	47.5	.000669				
55	.92535	308.9	54.0	.000760	.92100	303.7	41.4	.000583				
56	.95585	339.7	252.9	.003561	.95188	331.5	215.1	.003028				
57	.93041	319.3	99.4	.001399	.92507	310.9	80.7	.001136				
58	.92654	313.7	68.4	.000963	.92168	304.0	50.9	.000716				
59	.92580	309.4	56.3	.000792	.92055	302.6	42.1	.000592				
60	.95615	338.8	226.3	.003187	.95165	330.6	193.7	.002725				
61	.92535	314.1	98.6	.001389	.91995	309.2	78.0	.001098				
62	.92387	309.4	60.4	.000850	.91957	304.2	45.1	.000635				
63	.92759	307.4	38.2	.000539	.92514	302.8	28.0	.000394				
64	.93145	308.8	34.1	.000480	.93651	307.3	35.7	.000503				
65	.94752	317.7	48.0	.000677	.95037	316.9	72.0	.001013				
66	.94842	335.7	220.9	.003111	.94465	327.8	188.2	.002650				
67	.93607	326.7	176.9	.002491	.93260	319.4	152.5	.002146				
68	.92952	320.1	138.5	.001950	.92718	317.1	118.4	.001666				
69	.93012	311.1	53.0	.000747	.92778	305.2	43.9	.000618				
70	.93279	310.3	44.4	.000625	.93847	308.7	39.4	.000554				
71	.95169	319.9	49.0	.000689	.94992	319.0	88.4	.001244				

[a] h measured in J/m^2-sec-$^\circ$K

TABLE II.- TABULATION OF HEAT-TRANSFER MEASUREMENTS ON CLEAN MODEL AT A NOMINAL REYNOLDS NUMBER BASED ON MODEL LENGTH OF 3.0×10^6 - Continued

(i) $\alpha = 10^o$

Thermo-couple	$\beta = -10^o$; $T_w = 389^o$ K; $p_t = 278.5$ kN/m^2				$\beta = -5^o$; $T_w = 389^o$ K; $p_t = 278.5$ kN/m^2				$\beta = 0^o$; $T_w = 391^o$ K; $p_t = 278.3$ kN/m^2			
	$\frac{T_e}{T_t}$	T_w, ^{o}K	h (a)	N_{St}	$\frac{T_e}{T_t}$	T_w, ^{o}K	h (a)	N_{St}	$\frac{T_e}{T_t}$	T_w, ^{o}K	h (a)	N_{St}
1	.97827	362.3	430.5	.006050	.97504	361.6	505.9	.007104	.97426	360.7	564.9	.007971
2	.98853	367.1	464.3	.006525	.98523	366.1	548.6	.007703	.98383	365.3	617.9	.008718
3	.98997	365.4	421.6	.005925	.98667	364.2	483.5	.006789	.98528	363.0	531.3	.007497
4	.98954	360.8	354.7	.004984	.98624	359.5	397.4	.005581	.98470	358.1	428.4	.006045
5	.98896	356.6	303.1	.004259	.98552	355.4	336.6	.004727	.98412	353.9	357.7	.005047
6	.98961	356.4	284.8	.004002	.98602	355.2	317.0	.004451	.98427	354.0	341.6	.004821
7	.98247	353.0	290.0	.004076	.97831	351.8	324.4	.004555	.97711	350.9	349.7	.004934
8	.96446	343.2	256.3	.003602	.96051	341.9	281.9	.003958	.95910	341.0	304.6	.004298
9	.95089	331.0	186.5	.002622	.94695	329.5	200.5	.002816	.94544	328.4	212.4	.002997
10	.95171	320.8	87.9	.001236	.94837	319.8	93.0	.001306	.94649	318.6	99.0	.001398
11	.95606	321.0	75.4	.001060	.95376	320.3	79.9	.001122	.95144	319.0	85.8	.001210
12	.95966	321.3	66.9	.000940	.95586	320.1	74.3	.001043	.95385	318.9	79.1	.001116
13	.96101	350.9	331.2	.004655	.95721	349.7	376.1	.005281	.95535	348.4	430.9	.006081
14	.93049	320.7	151.2	.002126	.92672	319.3	158.8	.002230	.92488	317.6	165.2	.002331
15	.92126	304.1	38.7	.000544	.91773	302.7	38.5	.000541	.91663	303.6	43.0	.000607
16	.92366	302.9	23.5	.000330	.92230	304.3	34.4	.000483	.92248	304.1	38.1	.000538
17	.93806	308.0	31.4	.000441	.93444	311.3	50.2	.000705	.93118	306.4	39.4	.000556
18	.93731	305.3	18.0	.000253	.93114	309.4	46.2	.000649	.93358	308.0	42.1	.000593
19	.93079	302.4	14.2	.000200	.93354	308.7	39.4	.000553	.93659	309.0	42.3	.000596
20	.91841	300.1	23.8	.000335	.91683	299.8	25.0	.000351	.91783	301.4	31.9	.000451
21	.93154	305.4	20.9	.000293	.93234	305.1	24.6	.000345	.92428	303.2	29.3	.000414
22	.93079	303.1	19.4	.000273	.92410	301.5	17.4	.000245	.92008	300.5	23.0	.000324
23	.93536	303.8	15.4	.000216	.92972	301.9	12.0	.000169	.91377	297.7	21.2	.000300
24	.95479	343.8	292.2	.004106	.94800	340.0	306.7	.004306	.94349	336.4	310.0	.004374
25	.93926	327.5	196.2	.002758	.93301	323.7	196.1	.002753	.92893	319.7	188.2	.002656
26	.92936	314.9	107.6	.001512	.92320	311.1	99.1	.001392	.91993	307.5	89.0	.001255
27	.92066	307.4	68.2	.000959	.91488	304.0	58.7	.000825	.91317	301.1	50.0	.000705
28	.92554	307.2	53.1	.000747	.92125	304.6	46.7	.000655	.91753	301.3	39.3	.000554
29	.92629	305.8	43.5	.000611	.91975	302.5	36.2	.000509	.91505	299.2	29.8	.000420
30	.93146	307.5	37.7	.000531	.92305	303.0	29.4	.000413	.91753	299.3	25.7	.000363
31	.97541	360.0	400.8	.005632	.96755	356.1	439.9	.006177	.96210	352.3	456.9	.006446
32	.95434	338.8	243.7	.003425	.94522	333.1	236.2	.003317	.93876	327.5	223.0	.003146
33	.94646	325.2	141.9	.001994	.93676	319.7	130.2	.001828	.92976	314.1	115.5	.001629
34	.94166	320.8	108.4	.001523	.93189	315.4	98.0	.001377	.92503	310.1	85.5	.001206
35	.93806	318.5	100.0	.001405	.92822	313.0	89.5	.001257	.92173	307.9	77.0	.001086
36	.93596	316.0	86.3	.001213	.92672	310.8	76.1	.001069	.92053	306.1	65.0	.000917
37	.97511	359.2	400.1	.005623	.96605	354.4	430.4	.006043	.96090	350.4	431.3	.006086
38	.95734	335.0	206.9	.002907	.94687	328.8	194.8	.002735	.93869	322.5	177.8	.002509
39	.95411	338.1	154.1	.002166	.94357	331.2	140.3	.001970	.93569	320.6	120.7	.001703
40	.95029	323.2	114.0	.001603	.93923	317.6	103.9	.001459	.93118	312.0	90.8	.001281
41	.94871	321.3	100.6	.001413	.93773	315.7	91.2	.001280	.92983	310.2	79.0	.001114
42	.94721	319.4	87.9	.001236	.93638	313.9	78.8	.001106	.92833	308.7	68.4	.000965
43	.97752	357.0	364.8	.005127	.96815	351.9	380.0	.005336	.96120	346.8	379.0	.005348
44	.95989	343.1	176.7	.002483	.94912	331.5	157.7	.002214	.94049	320.4	145.5	.002053
45	.95666	332.4	105.5	.001483	.94530	319.0	94.0	.001319	.93659	313.1	82.5	.001165
46	.95426	322.1	92.9	.001305	.94305	316.7	84.4	.001185	.93449	311.2	74.3	.001048
47	.95171	320.5	87.9	.001235	.94005	315.2	79.4	.001115	.93178	309.9	69.8	.000985
48	.97887	354.9	325.7	.004577	.96957	349.8	338.1	.004747	.96270	344.7	334.0	.004712
49	.95366	319.0	70.1	.000985	.94223	313.9	63.6	.000893	.93298	308.6	54.9	.000774
50	.95516	316.3	48.3	.000679	.94492	311.4	40.6	.000570	.93509	305.9	31.7	.000447
51	.96709	323.8	52.2	.000734	.95751	319.6	52.8	.000742	.95144	318.7	73.3	.001034
52	.95906	340.4	160.1	.002249	.94777	329.2	143.3	.002013	.93929	323.2	132.6	.001871
53	.95816	333.7	119.5	.001680	.94657	319.8	100.8	.001415	.93749	314.1	96.6	.001363
54	.95636	323.2	99.9	.001405	.94492	317.6	91.0	.001278	.93614	312.0	79.6	.001123
55	.95404	321.2	87.7	.001233	.94260	315.9	80.1	.001125	.93358	310.4	70.8	.000999
56	.98052	352.1	307.4	.004320	.97167	347.2	315.8	.004435	.96480	342.4	311.8	.004400
57	.95959	339.2	152.0	.002136	.94837	332.6	141.9	.001992	.93951	322.3	126.4	.001784
58	.95696	331.6	108.3	.001521	.94545	318.7	98.0	.001377	.93599	313.0	88.6	.001250
59	.95456	321.1	85.9	.001207	.94298	316.0	79.6	.001117	.93419	310.8	71.6	.001010
60	.98024	350.5	272.8	.003834	.97129	345.8	281.2	.003948	.96465	341.2	278.4	.003928
61	.95411	327.8	144.2	.002026	.94328	322.1	135.6	.001904	.93494	316.4	123.1	.001737
62	.95351	321.6	91.8	.001289	.94245	316.4	84.2	.001182	.93373	310.9	74.6	.001052
63	.95666	319.7	69.7	.000979	.94560	314.5	61.9	.000869	.93674	309.6	54.5	.000769
64	.96019	319.7	60.6	.000852	.94972	314.9	51.3	.000720	.94094	310.8	45.3	.000639
65	.96971	324.2	50.6	.000711	.96223	324.2	63.3	.000890	.95460	324.5	118.5	.001672
66	.97399	347.8	268.5	.003774	.96515	343.2	276.5	.003882	.95820	338.8	275.2	.003883
67	.96304	340.1	230.3	.003237	.95406	335.2	229.5	.003223	.94754	330.8	225.8	.003186
68	.95651	333.5	187.5	.002635	.94785	328.8	182.7	.002566	.94169	324.3	177.3	.002502
69	.95786	323.8	88.2	.001240	.94882	319.3	83.2	.001168	.94184	314.8	76.8	.001083
70	.96379	324.2	83.2	.001170	.95526	320.0	77.6	.001090	.94514	314.6	70.7	.000997
71	.96476	323.4	72.2	.001015	.95736	319.9	68.6	.000963	.95685	318.3	56.9	.000803

[a] h measured in J/m^2-sec-^{o}K

TABLE II.- TABULATION OF HEAT-TRANSFER MEASUREMENTS ON CLEAN MODEL AT A NOMINAL REYNOLDS NUMBER BASED ON MODEL LENGTH OF 3.0×10^6 - Continued

(i) $\alpha = 10^{\circ}$ - Concluded

Thermocouple	$\beta = 5^{\circ}$; $T_w = 390^{\circ}$ K; $p_t = 278.3$ kN/m^2				$\beta = 10^{\circ}$; $T_w = 386^{\circ}$ K; $p_t = 277.6$ kN/m^2							
	$\frac{T_e}{T_t}$	T_w, $^{\circ}$K	h (a)	N_{St}	$\frac{T_e}{T_t}$	T_w, $^{\circ}$K	h (a)	N_{St}	$\frac{T_e}{T_t}$	T_w, $^{\circ}$K	h (a)	N_{St}
1	.97412	359.4	508.0	.007150	.97290	355.7	431.3	.006055				
2	.98382	363.2	534.8	.007527	.98291	359.5	453.5	.006367				
3	.98498	361.4	476.1	.006701	.98363	357.7	410.8	.005767				
4	.98454	356.6	389.5	.005482	.98327	353.5	345.3	.004847				
5	.98368	352.4	330.5	.004651	.98216	349.5	296.9	.004168				
6	.98397	352.3	312.0	.004391	.98224	349.3	279.2	.003919				
7	.97660	349.1	320.9	.004516	.97433	346.0	286.9	.004029				
8	.95888	339.4	280.5	.003947	.95731	336.9	253.8	.003563				
9	.94513	327.3	199.4	.002807	.94436	325.5	184.4	.002589				
10	.94656	318.1	94.9	.001336	.94549	316.5	88.6	.001244				
11	.95152	318.3	81.0	.001140	.95099	317.3	77.1	.001082				
12	.95377	318.2	74.5	.001048	.95422	317.3	68.0	.000955				
13	.95512	346.8	373.8	.005261	.95377	343.5	325.5	.004570				
14	.92478	316.7	154.8	.002179	.92373	315.0	146.5	.002057				
15	.91637	301.0	37.3	.000525	.91552	299.9	36.6	.000513				
16	.92148	303.1	34.1	.000481	.91770	299.6	25.2	.000353				
17	.93259	309.0	47.7	.000671	.93073	304.2	32.3	.000453				
18	.92824	307.7	49.3	.000693	.92855	300.8	18.1	.000254				
19	.92778	306.3	44.2	.000623	.92493	298.9	14.6	.000206				
20	.92027	303.3	36.1	.000508	.92207	302.5	40.5	.000568				
21	.92981	305.2	30.8	.000434	.93246	307.1	46.8	.000657				
22	.93740	306.6	29.1	.000410	.93969	306.5	32.0	.000449				
23	.93792	306.9	28.5	.000401	.94737	309.2	31.5	.000443				
24	.94070	332.7	270.2	.003803	.93675	328.0	232.3	.003262				
25	.92688	316.7	163.0	.002295	.92418	313.2	140.1	.001967				
26	.91892	308.1	71.4	.001006	.91748	302.7	56.0	.000786				
27	.91472	301.7	38.6	.000544	.91695	299.2	32.1	.000451				
28	.92313	301.8	31.6	.000444	.92930	302.9	29.3	.000411				
29	.92733	301.9	22.8	.000321	.94135	305.9	22.9	.000322				
30	.93672	307.3	30.0	.000423	.94730	309.2	33.2	.000466				
31	.95798	348.0	392.4	.005522	.95332	342.0	320.7	.004502				
32	.93424	322.5	185.6	.002613	.92915	317.2	154.9	.002175				
33	.92538	313.4	91.9	.001293	.92132	305.7	68.8	.000966				
34	.92118	306.3	66.5	.000937	.91800	302.5	50.4	.000708				
35	.91795	304.5	60.0	.000844	.91575	301.1	45.7	.000642				
36	.91787	303.3	50.8	.000715	.91748	300.9	39.7	.000558				
37	.95527	345.2	364.8	.005134	.94865	338.1	299.3	.004202				
38	.93274	322.2	144.8	.002038	.92719	312.0	112.6	.001581				
39	.92974	315.1	94.3	.001327	.92403	306.4	69.0	.000968				
40	.92538	307.5	70.7	.000995	.91996	302.9	50.4	.000708				
41	.92433	306.2	61.3	.000863	.91951	302.1	45.9	.000645				
42	.92328	305.1	53.2	.000749	.91951	301.6	41.4	.000582				
43	.95565	341.4	319.1	.004492	.94956	335.4	266.6	.003743				
44	.93394	315.3	111.7	.001572	.92742	310.0	89.6	.001258				
45	.92974	311.3	63.6	.000895	.92335	304.0	46.5	.000653				
46	.92809	306.9	57.7	.000812	.92154	302.5	42.6	.000598				
47	.92531	305.7	54.2	.000762	.91936	301.4	41.2	.000578				
48	.95708	339.5	284.2	.004000	.95106	333.7	237.2	.003331				
49	.92748	304.9	41.3	.000581	.92335	301.2	29.2	.000409				
50	.93515	305.1	24.7	.000348	.94300	309.1	37.1	.000521				
51	.94716	318.9	93.0	.001309	.94903	315.8	71.1	.000998				
52	.93214	317.6	107.4	.001512	.92501	308.3	82.4	.001156				
53	.93019	309.5	72.5	.001020	.92328	304.8	58.0	.000814				
54	.92899	310.1	63.2	.000890	.92162	303.1	48.6	.000683				
55	.92643	306.0	55.4	.000780	.91996	301.7	41.0	.000576				
56	.95933	337.5	267.9	.003770	.95325	332.0	226.9	.003186				
57	.93259	316.9	102.5	.001443	.92553	307.9	78.3	.001099				
58	.92869	311.3	70.2	.000988	.92192	303.8	53.2	.000747				
59	.92763	306.8	56.7	.000798	.92057	302.3	43.2	.000606				
60	.95948	336.5	239.6	.003372	.95332	331.0	201.8	.002833				
61	.92839	311.4	98.7	.001389	.92132	306.2	75.2	.001056				
62	.92718	306.5	53.8	.000757	.92109	302.0	40.5	.000569				
63	.93162	306.7	43.5	.000613	.92644	303.0	33.9	.000476				
64	.93860	309.1	37.3	.000526	.94052	309.6	41.7	.000586				
65	.95392	321.6	101.6	.001430	.95340	317.3	71.9	.001010				
66	.95347	334.1	235.9	.003320	.94737	328.8	198.8	.002791				
67	.94266	326.2	193.1	.002718	.93660	321.1	163.7	.002298				
68	.93740	320.3	150.1	.002113	.93201	315.7	128.5	.001805				
69	.93665	311.2	63.3	.000892	.93088	307.0	51.0	.000716				
70	.94055	312.0	56.9	.000801	.94579	313.4	53.4	.000750				
71	.95407	320.3	74.2	.001044	.95008	320.0	100.2	.001407				

[a] h measured in J/m^2-sec-$^{\circ}$K

TABLE II.- TABULATION OF HEAT-TRANSFER MEASUREMENTS ON CLEAN MODEL AT A NOMINAL REYNOLDS NUMBER BASED ON MODEL LENGTH OF 3.0×10^6 - Continued

(j) $\alpha = 20^{\circ}$

Thermocouple	$\beta = -10^{\circ}$; $T_w = 390^{\circ}$ K; $p_t = 278.0$ kN/m^2				$\beta = -5^{\circ}$; $T_w = 388^{\circ}$ K; $p_t = 278.0$ kN/m^2				$\beta = 0^{\circ}$; $T_w = 389^{\circ}$ K; $p_t = 277.8$ kN/m^2			
	$\frac{T_e}{T_t}$	T_w, $^{\circ}$K	h (a)	N_{St}	$\frac{T_e}{T_t}$	T_w, $^{\circ}$K	h (a)	N_{St}	$\frac{T_e}{T_t}$	T_w, $^{\circ}$K	h (a)	N_{St}
1	.96619	358.4	447.4	.006308	.96824	365.3	380.4	.005349	.96504	359.5	446.7	.006294
2	.98416	368.7	542.8	.007653	.98657	371.7	467.5	.006574	.98256	369.6	545.3	.007683
3	.98906	369.0	491.9	.006935	.99105	366.3	420.4	.005911	.98724	369.6	505.3	.007119
4	.99028	365.1	409.8	.005778	.99228	362.2	355.8	.005002	.98825	365.6	419.6	.005912
5	.99035	361.4	352.0	.004963	.99235	358.5	310.7	.004368	.98847	361.8	357.4	.005035
6	.99165	361.5	332.1	.004682	.99336	358.5	294.5	.004141	.98904	362.0	339.9	.004788
7	.98776	360.3	357.0	.005034	.98932	357.4	316.8	.004455	.98558	361.0	363.5	.005122
8	.97555	354.3	338.7	.004776	.97725	351.4	301.8	.004243	.97343	355.0	345.6	.004870
9	.96365	343.4	263.5	.003716	.96502	340.6	236.3	.003322	.96099	343.8	269.0	.003790
10	.96619	333.6	143.5	.002023	.96839	331.8	132.0	.001856	.96421	333.9	146.0	.002057
11	.96627	330.7	116.2	.001638	.96922	329.5	109.2	.001535	.96489	331.2	119.9	.001689
12	.96185	327.6	102.5	.001445	.96494	326.7	96.6	.001359	.96114	327.9	105.7	.001490
13	.94658	344.2	313.9	.004426	.94813	341.4	275.5	.003874	.94405	344.3	308.7	.004350
14	.92039	314.8	128.2	.001807	.92119	316.7	111.9	.001573	.91737	313.9	129.4	.001823
15	.91365	303.1	36.7	.000517	.91511	299.9	27.8	.000391	.91212	300.2	34.3	.000484
16	.92001	303.3	30.9	.000435	.92284	305.3	37.7	.000530	.92127	306.9	43.0	.000607
17	.92922	304.2	21.7	.000306	.92666	305.0	33.8	.000476	.92291	306.3	41.6	.000587
18	.93596	304.6	13.1	.000184	.93687	307.1	27.2	.000382	.92786	306.5	34.6	.000487
19	.96350	311.6	4.7	.000067	.94978	309.8	20.0	.000281	.93416	307.7	31.1	.000438
20	.91620	300.8	24.3	.000343	.91991	300.3	22.7	.000319	.91797	303.7	38.2	.000538
21	.92593	303.2	19.6	.000276	.92201	299.7	17.7	.000249	.92171	302.8	20.6	.000290
22	.93184	303.1	14.4	.000203	.93500	302.9	12.5	.000175	.92426	301.2	17.7	.000250
23	.93865	304.8	14.3	.000201	.93432	302.4	11.5	.000162	.93221	303.3	17.3	.000244
24	.94224	338.2	271.2	.003824	.94077	333.0	232.3	.003266	.93431	333.6	247.3	.003484
25	.92817	322.4	178.6	.002518	.92719	317.4	148.0	.002081	.92156	317.4	157.7	.002222
26	.91927	310.7	97.7	.001378	.91803	306.4	71.5	.001005	.91317	308.1	73.4	.001034
27	.91410	304.6	59.5	.000839	.91436	301.6	43.9	.000617	.91077	302.8	45.6	.000643
28	.91829	303.4	41.1	.000580	.91638	300.3	31.7	.000446	.91362	299.7	30.1	.000424
29	.93087	307.9	40.1	.000565	.93162	305.5	30.3	.000426	.92419	303.3	29.6	.000417
30	.92944	310.4	69.4	.000978	.92907	306.7	51.6	.000726	.92726	306.1	45.1	.000635
31	.96402	356.6	419.1	.005909	.96201	360.6	339.0	.004767	.95424	351.7	372.3	.005245
32	.94606	337.2	247.0	.003482	.94228	330.0	199.2	.002800	.93356	328.7	204.4	.002880
33	.93970	324.8	147.5	.002080	.93507	318.2	116.9	.001644	.92576	315.5	111.9	.001577
34	.93528	320.0	110.6	.001560	.93094	314.2	88.3	.001242	.92216	311.3	82.0	.001155
35	.93206	317.7	101.2	.001427	.92787	312.1	81.0	.001139	.91969	309.4	73.1	.001030
36	.92989	314.6	84.5	.001192	.92591	309.5	67.5	.000949	.91782	306.8	60.6	.000854
37	.96769	359.2	447.6	.006311	.96464	362.6	354.1	.004978	.95709	353.3	382.7	.005393
38	.95257	336.0	225.0	.003172	.94723	328.3	177.5	.002496	.93686	326.1	181.6	.002558
39	.95018	329.4	162.9	.002297	.94453	322.2	127.6	.001795	.93461	319.5	126.6	.001784
40	.94599	323.9	121.9	.001719	.94055	317.6	96.5	.001357	.93041	314.5	92.3	.001301
41	.94434	321.4	105.8	.001492	.93882	315.6	84.9	.001193	.92891	312.4	79.0	.001112
42	.94239	318.8	88.3	.001245	.93687	313.3	71.2	.001001	.92696	310.1	65.4	.000921
43	.97428	359.6	415.6	.005860	.97080	353.0	339.8	.004778	.96167	352.6	366.5	.005164
44	.95676	334.2	189.6	.002674	.95128	326.9	150.1	.002111	.94068	324.8	153.9	.002169
45	.95339	325.3	111.2	.001568	.94738	319.1	88.7	.001247	.93641	316.0	85.9	.001210
46	.95085	322.5	98.6	.001390	.94490	316.6	78.5	.001104	.93431	313.5	74.5	.001050
47	.94763	320.0	87.1	.001228	.94153	314.4	70.0	.000984	.93101	311.2	65.2	.000918
48	.97761	358.3	372.8	.005257	.97447	351.8	306.5	.004309	.96519	351.5	331.1	.004665
49	.95212	318.0	60.8	.000857	.94573	312.6	47.1	.000663	.93423	308.6	42.0	.000592
50	.96754	334.4	135.0	.001903	.96434	329.1	111.1	.001562	.95634	325.4	94.8	.001336
51	.96320	338.5	195.2	.002752	.96149	331.1	144.9	.002037	.95492	328.1	123.3	.001737
52	.95646	332.2	173.3	.002443	.95061	325.2	138.4	.001946	.94015	327.4	139.6	.001966
53	.95527	326.6	127.5	.001797	.94903	320.3	96.6	.001358	.93805	320.9	100.5	.001416
54	.95325	323.6	105.4	.001485	.94700	317.7	84.7	.001191	.93626	314.5	80.9	.001139
55	.95122	320.6	85.0	.001198	.94498	315.1	68.7	.000966	.93378	311.9	65.3	.000921
56	.98035	356.0	353.1	.004979	.97717	349.6	292.4	.004111	.96789	349.5	316.5	.004459
57	.95736	331.3	163.9	.002311	.95173	324.4	123.4	.001734	.94075	326.1	130.4	.001838
58	.95452	325.0	113.0	.001593	.94828	319.0	91.4	.001286	.93686	318.9	87.2	.001228
59	.95332	321.2	84.3	.001188	.94693	315.6	67.6	.000951	.93573	312.3	63.5	.000894
60	.98028	354.5	316.0	.004456	.97710	348.2	262.3	.003688	.96804	348.0	280.4	.003951
61	.95482	330.6	162.5	.002291	.94903	323.6	129.0	.001814	.93850	320.8	125.8	.001773
62	.95497	324.2	102.2	.001441	.94896	318.1	81.3	.001143	.93790	314.8	77.2	.001088
63	.95976	323.5	83.7	.001179	.95323	317.5	65.0	.000914	.94105	313.3	59.3	.000835
64	.96784	327.9	82.6	.001165	.96344	326.1	86.6	.001218	.95380	328.3	117.9	.001661
65	.96440	329.0	90.9	.001282	.96224	327.1	92.7	.001303	.95409	327.7	116.0	.001634
66	.97833	354.2	323.7	.004564	.97477	347.9	270.5	.003803	.96549	347.7	287.8	.004055
67	.97039	348.6	291.1	.004104	.96674	342.1	240.9	.003387	.95769	341.6	252.9	.003563
68	.96500	342.9	245.0	.003454	.96164	336.5	202.0	.002840	.95260	335.9	208.6	.002938
69	.96724	333.7	133.1	.001876	.96284	327.7	108.0	.001518	.95200	325.2	103.0	.001451
70	.96777	330.9	120.0	.001692	.96509	326.2	100.2	.001409	.95380	324.0	98.3	.001385
71	.96380	328.0	100.6	.001418	.96149	323.9	84.4	.001187	.95260	321.9	82.1	.001157

[a] h measured in J/m^2-sec-$^{\circ}$K

TABLE II.- TABULATION OF HEAT-TRANSFER MEASUREMENTS ON CLEAN MODEL AT A NOMINAL REYNOLDS NUMBER BASED ON MODEL LENGTH OF 3.0×10^6 - Continued

(j) $\alpha = 20^o$ - Concluded

Thermocouple	$\beta = 5^o$; $T_w = 388^o$ K; $p_t = 278.3$ kN/m^2				$\beta = 10^o$; $T_w = 387^o$ K; $p_t = 278.5$ kN/m^2							
	$\frac{T_e}{T_t}$	T_w, ^oK	h (a)	N_{St}	$\frac{T_e}{T_t}$	T_w, ^oK	h (a)	N_{St}	$\frac{T_e}{T_t}$	T_w, ^oK	h (a)	N_{St}
1	.96378	355.3	450.8	.006328	.96498	350.3	389.0	.005453				
2	.98150	365.2	547.4	.007685	.98276	359.6	457.0	.006407				
3	.98598	365.2	500.9	.007032	.98682	359.5	423.5	.005937				
4	.98684	361.0	414.0	.005811	.98783	356.2	361.2	.005064				
5	.98684	357.3	355.4	.004989	.98776	352.8	313.2	.004391				
6	.98771	357.4	335.8	.004713	.98856	352.7	295.6	.004144				
7	.98388	356.5	361.0	.005068	.98436	351.6	318.0	.004457				
8	.97175	350.6	343.9	.004827	.97236	346.1	305.9	.004289				
9	.95972	339.8	265.0	.003720	.96092	336.2	239.2	.003354				
10	.96288	330.8	146.3	.002054	.96310	328.1	135.6	.001901				
11	.96295	328.1	118.6	.001666	.96317	325.4	109.1	.001530				
12	.95874	324.8	105.6	.001483	.95835	322.2	96.8	.001357				
13	.94259	340.0	307.8	.004322	.94389	336.0	273.7	.003837				
14	.91613	315.1	123.3	.001731	.91738	309.1	114.7	.001608				
15	.91079	300.3	34.7	.000487	.91211	297.5	27.3	.000382				
16	.91944	303.6	38.8	.000545	.91882	300.1	29.5	.000413				
17	.91929	303.1	38.0	.000533	.92537	301.0	23.1	.000324				
18	.92334	303.1	29.8	.000418	.93441	302.2	12.2	.000172				
19	.93235	304.6	24.3	.000341	.97010	311.8	4.8	.000067				
20	.91853	303.1	46.9	.000658	.92220	305.0	53.0	.000744				
21	.92184	300.8	23.6	.000332	.92582	302.6	34.3	.000481				
22	.93266	303.7	20.2	.000283	.94141	305.4	21.4	.000301				
23	.93507	303.9	16.5	.000231	.94954	307.2	16.2	.000228				
24	.93116	327.5	230.3	.003232	.93004	322.6	199.8	.002801				
25	.91883	316.6	138.4	.001942	.91866	308.7	118.8	.001665				
26	.91147	304.0	59.2	.000831	.91249	303.9	51.2	.000717				
27	.91177	300.8	39.2	.000550	.91671	299.7	35.7	.000500				
28	.91523	298.6	24.5	.000344	.92296	299.9	23.9	.000335				
29	.92906	304.7	27.0	.000380	.94148	306.2	25.3	.000354				
30	.93026	306.0	35.3	.000495	.94525	307.6	29.1	.000408				
31	.94943	344.8	353.5	.004962	.94751	337.9	294.8	.004132				
32	.92823	321.1	177.4	.002490	.92567	315.4	145.7	.002043				
33	.92049	312.2	88.9	.001248	.91829	310.0	71.4	.001000				
34	.91763	305.8	66.8	.000937	.91656	302.2	51.9	.000728				
35	.91508	304.2	60.6	.000850	.91460	301.1	47.9	.000671				
36	.91387	302.2	49.3	.000692	.91497	299.9	38.9	.000545				
37	.95115	345.5	351.1	.004928	.94661	337.2	291.9	.004092				
38	.92936	322.9	152.3	.002138	.92612	320.8	124.9	.001751				
39	.92710	315.9	100.7	.001414	.92326	313.4	81.9	.001148				
40	.92319	310.7	73.8	.001036	.91949	303.5	58.9	.000825				
41	.92229	306.4	63.7	.000894	.91889	302.5	50.4	.000706				
42	.92034	304.7	53.4	.000749	.91844	301.3	40.9	.000574				
43	.95521	344.5	334.3	.004693	.95128	337.2	276.7	.003879				
44	.93327	321.7	127.8	.001793	.92883	319.2	105.3	.001476				
45	.92876	312.4	69.2	.000971	.92446	307.5	53.7	.000753				
46	.92665	307.5	61.3	.000861	.92213	303.2	47.9	.000671				
47	.92334	305.4	53.7	.000754	.91927	301.4	41.1	.000576				
48	.95852	343.5	302.6	.004248	.95489	336.3	249.7	.003500				
49	.92725	304.9	31.7	.000445	.92507	303.0	24.5	.000344				
50	.95055	318.6	75.0	.001053	.94999	316.3	69.5	.000974				
51	.95160	321.7	100.2	.001406	.95052	316.6	74.1	.001038				
52	.93221	319.6	116.3	.001633	.92702	317.0	97.0	.001360				
53	.92996	317.0	86.4	.001213	.92507	311.0	66.2	.000927				
54	.92831	310.8	65.9	.000925	.92303	310.0	54.0	.000757				
55	.92560	306.1	54.0	.000758	.92100	301.9	41.3	.000578				
56	.96138	341.7	288.8	.004055	.95760	334.9	240.3	.003369				
57	.93281	318.4	107.5	.001509	.92778	315.8	88.7	.001244				
58	.92906	312.0	70.8	.000993	.92439	309.1	56.1	.000787				
59	.92846	308.5	49.6	.000697	.92341	302.1	38.4	.000539				
60	.96168	340.5	256.6	.003603	.95798	333.7	214.4	.003006				
61	.93101	317.2	103.1	.001448	.92567	317.2	85.8	.001203				
62	.93026	311.0	60.9	.000855	.92522	308.0	47.7	.000669				
63	.93357	309.6	46.5	.000653	.92906	308.4	37.1	.000520				
64	.94710	317.9	80.1	.001124	.94480	311.2	47.8	.000671				
65	.94950	319.8	90.7	.001274	.94450	310.4	45.6	.000639				
66	.95912	340.1	264.0	.003706	.95564	333.3	218.3	.003060				
67	.95145	334.1	228.0	.003201	.94736	327.5	190.6	.002672				
68	.94710	328.7	188.1	.002641	.94344	323.0	157.6	.002209				
69	.94484	318.4	92.9	.001304	.93923	313.3	75.5	.001059				
70	.95100	319.2	79.6	.001118	.95052	316.9	71.0	.000996				
71	.95228	318.4	65.3	.000916	.95120	316.7	56.9	.000798				

[a] h measured in J/m^2-sec-^{o}K

TABLE II.- TABULATION OF HEAT-TRANSFER MEASUREMENTS ON CLEAN MODEL AT A NOMINAL REYNOLDS NUMBER BASED ON MODEL LENGTH OF 3.0×10^6 - Continued

(k) $\alpha = 30^{\circ}$

Thermocouple	$\beta = -10^{\circ}$; $T_w = 388^{\circ}$ K; $p_t = 278.8$ kN/m^2				$\beta = -5^{\circ}$; $T_w = 389^{\circ}$ K; $p_t = 277.9$ kN/m^2				$\beta = 0^{\circ}$; $T_w = 389^{\circ}$ K; $p_t = 278.8$ kN/m^2			
	$\frac{T_e}{T_t}$	T_w, $^{\circ}$K	h (a)	N_{St}	$\frac{T_e}{T_t}$	T_w, $^{\circ}$K	h (a)	N_{St}	$\frac{T_e}{T_t}$	T_w, $^{\circ}$K	h (a)	N_{St}
1	.95240	362.7	341.2	.004781	.95612	358.9	314.1	.004422	.95538	349.5	357.0	.005004
2	.97754	370.9	494.2	.006925	.98146	371.0	416.8	.005868	.98052	365.0	469.5	.006582
3	.98560	369.0	477.4	.006690	.98925	376.3	400.8	.005643	.98849	367.1	461.2	.006465
4	.98754	366.1	414.4	.005808	.99141	367.2	365.3	.005144	.99052	364.1	399.9	.005606
5	.98862	363.2	359.7	.005041	.99214	364.5	328.1	.004619	.99160	361.2	351.2	.004924
6	.99050	363.8	347.1	.004864	.99372	364.9	316.2	.004452	.99319	361.6	337.0	.004724
7	.98992	365.1	392.1	.005495	.99293	366.0	357.4	.005031	.99254	362.9	380.5	.005333
8	.98243	362.4	399.9	.005604	.98557	363.5	364.9	.005138	.98545	360.6	392.0	.005495
9	.97366	354.0	332.4	.004658	.97690	355.1	308.1	.004337	.97691	352.1	323.3	.004532
10	.97456	343.5	195.7	.002743	.97795	344.6	187.3	.002637	.97856	342.0	193.5	.002712
11	.96759	336.9	153.1	.002146	.97082	337.9	147.7	.002079	.97126	335.3	151.0	.002117
12	.96018	332.3	136.9	.001919	.96279	333.2	130.9	.001842	.96366	330.9	135.8	.001904
13	.93218	334.8	243.0	.003405	.93518	335.7	220.9	.003110	.93415	332.6	236.2	.003311
14	.91017	307.7	94.3	.001321	.91328	312.3	94.2	.001326	.91239	309.5	93.9	.001316
15	.90590	298.0	29.0	.000406	.90968	299.3	29.3	.000413	.90961	299.3	31.2	.000438
16	.91092	299.9	26.9	.000376	.91403	302.0	30.2	.000425	.91443	301.1	33.4	.000469
17	.92275	302.6	20.5	.000287	.92385	304.3	26.7	.000376	.92896	304.6	30.1	.000421
18	.94319	307.8	13.7	.000193	.93181	305.9	22.7	.000320	.94258	307.5	23.3	.000326
19	.95097	309.7	12.0	.000169	.94629	309.6	18.9	.000266	.94379	307.5	22.3	.000312
20	.91047	297.8	20.9	.000293	.91433	299.3	24.2	.000341	.91473	298.6	29.5	.000413
21	.91916	299.0	13.0	.000183	.92003	299.1	12.4	.000175	.92625	300.1	14.7	.000206
22	.94259	306.5	14.6	.000204	.92558	300.7	15.5	.000219	.94800	306.5	14.7	.000206
23	.93840	305.3	15.6	.000219	.94299	306.2	14.5	.000204	.94251	304.7	14.8	.000207
24	.92866	329.4	218.7	.003065	.93008	328.3	190.9	.002688	.92677	323.1	191.6	.002686
25	.91661	314.8	144.4	.002024	.91838	313.7	126.3	.001779	.91608	316.9	122.0	.001710
26	.90890	305.0	75.6	.001060	.91058	303.7	61.3	.000862	.90916	302.1	54.9	.000769
27	.90733	301.2	51.6	.000723	.90953	300.5	43.5	.000613	.90991	299.6	37.3	.000523
28	.91219	300.0	31.6	.000443	.91283	298.8	23.8	.000335	.91766	298.9	20.1	.000282
29	.92986	310.6	64.4	.000902	.92513	306.7	50.6	.000713	.93776	309.3	41.4	.000580
30	.92170	309.7	78.9	.001105	.92528	308.5	63.1	.000889	.92805	305.5	52.1	.000730
31	.95030	360.8	315.8	.004426	.95019	351.5	291.4	.004103	.94589	341.8	296.5	.004156
32	.93473	331.4	216.1	.003028	.93338	328.3	180.7	.002544	.92813	321.1	169.8	.002380
33	.93024	321.0	135.5	.001899	.92828	317.6	111.0	.001563	.92248	310.7	96.8	.001357
34	.92739	316.7	100.8	.001413	.92566	313.6	82.5	.001162	.92067	307.6	71.6	.001003
35	.92440	314.4	91.6	.001283	.92213	311.3	74.9	.001055	.91766	305.7	64.7	.000908
36	.92200	310.8	72.7	.001018	.91988	308.0	59.0	.000830	.91669	303.2	49.9	.000700
37	.95711	354.6	385.7	.005405	.95597	359.1	312.0	.004392	.95131	346.3	323.9	.004540
38	.94439	333.2	214.2	.003002	.94119	329.5	178.9	.002518	.93430	321.6	162.6	.002279
39	.94221	326.6	155.4	.002178	.93908	322.9	129.7	.001826	.93189	319.6	113.8	.001595
40	.93870	321.1	115.1	.001613	.93518	317.6	95.9	.001350	.92843	310.9	83.3	.001168
41	.93727	318.7	98.1	.001375	.93361	315.2	81.5	.001148	.92753	309.0	70.6	.000990
42	.93578	315.5	77.1	.001080	.93181	312.2	63.2	.000890	.92617	306.6	54.0	.000757
43	.96812	357.9	393.9	.005521	.96639	355.4	327.8	.004615	.96020	348.6	334.0	.004682
44	.95000	332.3	185.9	.002606	.94659	328.8	157.0	.002210	.93965	321.1	141.6	.001986
45	.94648	322.9	107.3	.001504	.94261	319.6	89.8	.001265	.93528	312.8	79.2	.001110
46	.94401	319.9	92.6	.001297	.93991	316.5	77.3	.001089	.93302	310.3	67.7	.000949
47	.94147	316.5	74.6	.001045	.93683	313.1	61.5	.000866	.93054	307.4	52.2	.000732
48	.97276	357.6	365.2	.005118	.97104	355.3	311.0	.004378	.96501	348.4	310.1	.004347
49	.95135	319.3	67.6	.000947	.94689	316.1	57.5	.000809	.94281	311.7	52.8	.000740
50	.96003	339.0	195.6	.002741	.95784	334.7	158.1	.002226	.95402	327.0	130.0	.001823
51	.95315	340.6	237.3	.003326	.95124	335.8	186.3	.002623	.94875	328.2	154.0	.002159
52	.94985	330.4	170.7	.002393	.94606	326.8	144.8	.002039	.93874	323.8	128.2	.001797
53	.94850	324.6	118.9	.001666	.94434	321.1	106.4	.001497	.93701	317.6	90.8	.001272
54	.94641	321.1	99.4	.001392	.94231	317.8	84.4	.001188	.93535	311.3	72.4	.001015
55	.94558	317.5	73.9	.001036	.94089	314.0	61.5	.000866	.93430	308.1	51.3	.000719
56	.97576	356.0	355.8	.004986	.97420	353.7	307.1	.004323	.96833	346.8	301.4	.004225
57	.95105	329.5	161.5	.002263	.94719	325.8	129.8	.001827	.94017	322.7	118.6	.001662
58	.94880	322.8	107.7	.001510	.94434	319.3	90.5	.001274	.93746	315.6	76.3	.001069
59	.94888	319.0	77.8	.001090	.94434	315.4	60.7	.000855	.93776	309.5	51.0	.000715
60	.97650	355.1	322.2	.004515	.97487	352.8	278.4	.003919	.96908	345.9	272.6	.003820
61	.95127	330.4	165.4	.002318	.94704	326.4	137.8	.001940	.94010	318.9	121.3	.001701
62	.95157	324.3	109.4	.001533	.94689	320.5	91.2	.001284	.93972	316.8	76.6	.001074
63	.95636	325.6	100.1	.001403	.95154	323.5	94.8	.001335	.94499	316.4	80.1	.001123
64	.95449	322.0	74.2	.001040	.95049	320.4	73.8	.001039	.94364	317.3	57.4	.000804
65	.95464	327.8	111.2	.001558	.95169	323.9	86.0	.001211	.94702	318.4	82.7	.001159
66	.97804	357.2	347.1	.004864	.97600	354.7	301.7	.004247	.97036	347.8	294.1	.004122
67	.97321	353.6	323.6	.004535	.97089	350.9	280.0	.003942	.96501	343.9	271.0	.003798
68	.96984	349.1	281.8	.003949	.96744	346.4	246.0	.003463	.96193	339.4	233.9	.003278
69	.95689	332.9	143.3	.002009	.95431	330.0	124.8	.001757	.94921	324.1	116.0	.001625
70	.96243	332.8	142.4	.001996	.96009	330.0	123.6	.001740	.95508	324.2	113.6	.001592
71	.95629	328.8	120.8	.001694	.95416	326.8	104.8	.001475	.95131	321.9	94.9	.001331

[a] h measured in J/m^2-sec-$^{\circ}$K

TABLE II.- TABULATION OF HEAT-TRANSFER MEASUREMENTS ON CLEAN MODEL AT A NOMINAL REYNOLDS NUMBER BASED ON MODEL LENGTH OF 3.0×10^6 - Continued

(k) $\alpha = 30^\circ$ - Concluded.

Thermocouple	$\beta = 5^\circ$; $T_w = 388^\circ$ K; $p_t = 278.4$ kN/m^2				$\beta = 10^\circ$; $T_w = 389^\circ$ K; $p_t = 277.5$ kN/m^2							
	$\frac{T_e}{T_t}$	T_w, $^\circ$K	h (a)	N_{St}	$\frac{T_e}{T_t}$	T_w, $^\circ$K	h (a)	N_{St}	$\frac{T_e}{T_t}$	T_w, $^\circ$K	h (a)	N_{St}
1	.95609	347.4	377.9	.005303	.95087	346.3	348.0	.004908				
2	.98091	362.3	494.9	.006946	.97527	360.6	446.0	.006290				
3	.98868	364.7	478.9	.006721	.98281	362.9	437.6	.006171				
4	.99078	361.7	399.4	.005605	.98505	359.9	376.9	.005315				
5	.99144	358.8	353.3	.004959	.98577	357.1	334.1	.004712				
6	.99296	359.1	337.3	.004734	.98736	357.3	317.5	.004478				
7	.99216	360.3	385.3	.005408	.98657	358.4	356.9	.005033				
8	.98534	358.2	396.4	.005564	.98021	356.3	365.7	.005158				
9	.97676	349.8	324.6	.004556	.97197	348.3	304.5	.004294				
10	.97737	339.7	195.2	.002739	.97182	338.2	183.4	.002587				
11	.96982	333.1	151.7	.002129	.96468	331.8	142.8	.002013				
12	.96258	328.8	136.3	.001913	.95860	328.1	128.7	.001815				
13	.93451	330.5	244.2	.003428	.92977	329.8	230.9	.003256				
14	.91248	312.0	94.3	.001324	.90860	304.4	85.7	.001209				
15	.90908	296.4	26.0	.000365	.90544	296.0	25.0	.000353				
16	.91376	299.6	31.9	.000448	.91055	298.4	26.4	.000373				
17	.92410	301.7	27.3	.000384	.92166	300.3	18.7	.000263				
18	.93707	304.8	21.5	.000301	.94133	305.2	10.4	.000147				
19	.96235	312.0	17.3	.000243	.95229	308.6	12.9	.000181				
20	.91444	299.4	37.9	.000531	.91235	301.9	45.6	.000643				
21	.92191	298.9	20.3	.000285	.92031	301.6	29.7	.000419				
22	.94092	304.2	14.2	.000199	.93427	303.4	17.5	.000247				
23	.93768	303.4	16.2	.000228	.93112	303.1	18.9	.000267				
24	.92485	319.3	179.2	.002515	.91866	317.1	168.5	.002376				
25	.91466	313.6	106.9	.001500	.90995	307.9	92.5	.001304				
26	.90840	297.6	42.4	.000595	.90529	297.0	37.0	.000522				
27	.91082	300.2	35.3	.000496	.91055	298.4	33.3	.000470				
28	.91625	298.5	19.0	.000267	.91828	299.0	20.0	.000282				
29	.93390	304.8	35.6	.000500	.92932	303.9	30.4	.000429				
30	.92696	303.2	42.6	.000599	.92737	303.9	35.6	.000502				
31	.94303	337.1	293.8	.004124	.93533	333.7	257.9	.003637				
32	.92410	315.7	149.1	.002093	.91640	312.1	130.0	.001833				
33	.91806	305.9	80.7	.001132	.91085	302.8	60.6	.000855				
34	.91670	303.6	60.0	.000842	.91055	301.2	49.5	.000699				
35	.91391	301.9	54.7	.000768	.90867	300.1	45.2	.000638				
36	.91293	299.9	42.3	.000594	.90920	298.7	34.3	.000483				
37	.94711	340.7	317.5	.004456	.93788	336.3	272.5	.003843				
38	.92862	315.6	139.5	.001957	.91933	311.4	114.5	.001614				
39	.92606	317.5	97.6	.001370	.91701	306.2	73.0	.001029				
40	.92236	306.1	69.9	.000981	.91408	303.0	56.6	.000798				
41	.92168	304.5	58.7	.000824	.91400	301.7	47.6	.000672				
42	.92047	302.5	45.1	.000633	.91363	300.2	35.5	.000501				
43	.95533	342.8	312.6	.004387	.94569	338.2	277.6	.003915				
44	.93345	315.5	122.0	.001712	.92384	311.3	97.8	.001379				
45	.92885	307.9	65.6	.000920	.91926	304.5	50.4	.000711				
46	.92651	305.6	56.3	.000790	.91731	302.5	44.8	.000631				
47	.92394	303.0	42.8	.000600	.91580	300.3	31.4	.000443				
48	.96046	342.6	286.5	.004021	.95042	337.8	255.4	.003602				
49	.93677	308.3	46.6	.000654	.92962	306.5	41.2	.000581				
50	.94522	319.0	100.5	.001410	.93533	311.7	62.4	.000879				
51	.94658	321.1	117.8	.001654	.94381	313.9	57.9	.000816				
52	.93217	313.5	110.9	.001556	.92234	309.4	86.7	.001223				
53	.93028	315.0	77.7	.001090	.92031	305.1	57.0	.000804				
54	.92840	306.3	59.7	.000839	.91866	308.9	49.6	.000699				
55	.92742	303.6	40.9	.000574	.91836	300.7	29.2	.000411				
56	.96348	341.1	279.2	.003919	.95350	336.6	248.8	.003508				
57	.93345	320.4	103.1	.001447	.92316	308.6	77.2	.001088				
58	.93043	307.6	64.5	.000905	.92046	304.0	46.9	.000661				
59	.93089	308.7	43.4	.000609	.92151	301.8	29.8	.000421				
60	.96409	340.2	251.8	.003534	.95432	335.7	223.1	.003147				
61	.93360	313.1	102.9	.001444	.92354	308.7	76.9	.001085				
62	.93270	308.7	64.6	.000907	.92264	304.9	47.8	.000674				
63	.93722	309.1	56.3	.000790	.92556	307.4	38.5	.000543				
64	.93406	307.1	43.5	.000611	.91956	301.6	29.7	.000419				
65	.94205	314.9	80.8	.001135	.93127	308.7	54.6	.000770				
66	.96560	342.1	271.1	.003805	.95567	337.4	238.2	.003360				
67	.95994	338.0	248.2	.003484	.95034	333.4	216.7	.003056				
68	.95707	333.7	211.8	.002973	.94771	329.3	184.2	.002597				
69	.94311	319.3	106.2	.001490	.93247	314.9	91.3	.001288				
70	.95013	320.0	100.1	.001405	.94554	320.1	93.9	.001324				
71	.95548	321.4	80.7	.001133	.95012	327.9	138.1	.001947				

[a] h measured in J/m^2-sec-$^\circ$K

TABLE II.- TABULATION OF HEAT-TRANSFER MEASUREMENTS ON CLEAN MODEL AT A NOMINAL REYNOLDS NUMBER BASED ON MODEL LENGTH OF 3.0×10^6 - Continued

(l) $\alpha = 40^\circ$

Thermocouple	$\beta = -10^\circ$; $T_w = 389^\circ$ K; $p_t = 277.9$ kN/m^2				$\beta = -5^\circ$; $T_w = 389^\circ$ K; $p_t = 278.8$ kN/m^2				$\beta = 0^\circ$ $T_w = 389^\circ$ K; $p_t = 279.3$ kN/m^2			
	$\frac{T_e}{T_t}$	T_w, $^\circ$K	h (a)	N_{St}	$\frac{T_e}{T_t}$	T_w, $^\circ$K	h (a)	N_{St}	$\frac{T_e}{T_t}$	T_w, $^\circ$K	h (a)	N_{St}
1	.94464	345.9	313.5	.004417	.94756	353.2	267.2	.003752	.94636	347.0	270.0	.003781
2	.97505	356.0	533.4	.007516	.97810	369.8	380.5	.005342	.97709	365.5	374.4	.005244
3	.98653	370.1	481.7	.006787	.98980	375.6	409.1	.005744	.98867	370.7	393.4	.005510
4	.98970	358.0	414.0	.005834	.99306	376.1	373.6	.005246	.99172	370.0	359.8	.005038
5	.99128	356.0	367.5	.005179	.99443	358.7	366.0	.005138	.99339	360.0	324.4	.004542
6	.99388	356.8	353.7	.004985	.99682	359.4	353.2	.004958	.99586	360.8	313.5	.004390
7	.99618	359.9	413.6	.005829	.99920	362.4	416.0	.005840	.99826	363.9	368.3	.005157
8	.99373	360.8	455.1	.006412	.99675	363.4	458.3	.006434	.99622	365.0	400.2	.005605
9	.98927	355.6	393.8	.005549	.99219	358.2	398.2	.005591	.99187	359.7	353.0	.004944
10	.98538	344.6	239.7	.003377	.98850	346.6	240.3	.003374	.98824	347.7	222.0	.003109
11	.97940	338.6	185.9	.002619	.98221	340.3	187.9	.002638	.98215	341.2	174.5	.002443
12	.97860	336.2	163.5	.002303	.98141	337.5	165.0	.002316	.98125	338.2	153.9	.002155
13	.92576	320.4	191.7	.002701	.92741	322.5	197.3	.002770	.92613	330.5	180.7	.002531
14	.91018	303.7	59.8	.000843	.91078	304.1	70.4	.000989	.90876	303.2	68.7	.000962
15	.91295	298.1	18.4	.000259	.91184	298.6	25.3	.000356	.90778	295.5	22.4	.000314
16	.92816	302.3	13.1	.000185	.92380	300.9	19.1	.000268	.91344	296.9	19.7	.000276
17	.94936	309.1	13.9	.000196	.94628	307.8	19.1	.000269	.92431	303.5	24.5	.000342
18	.92082	302.9	34.1	.000480	.93297	305.5	30.2	.000424	.92054	299.5	21.9	.000307
19	.94059	306.6	17.5	.000247	.93944	306.1	22.8	.000320	.94787	309.1	25.1	.000352
20	.92546	300.9	13.4	.000189	.92342	300.2	16.9	.000237	.91223	295.4	18.5	.000259
21	.93909	305.0	11.5	.000162	.94335	305.3	12.6	.000177	.92862	299.0	10.9	.000152
22	.94756	307.9	13.9	.000196	.95368	308.7	12.7	.000178	.94636	305.4	13.2	.000185
23	.94988	309.4	16.4	.000231	.95734	311.3	17.6	.000247	.95784	310.0	18.8	.000263
24	.92389	316.9	172.3	.002428	.92425	317.3	169.9	.002386	.92069	315.3	149.8	.002098
25	.91497	309.9	101.5	.001430	.91522	309.2	103.6	.001455	.91193	306.7	90.5	.001268
26	.91295	304.4	60.0	.000845	.91161	302.4	56.6	.000794	.90687	299.0	46.0	.000644
27	.91685	301.7	43.1	.000608	.91627	300.0	38.4	.000539	.90770	295.8	31.6	.000443
28	.92651	303.7	31.9	.000450	.92966	304.2	27.6	.000388	.92099	298.4	22.1	.000309
29	.93512	308.2	42.6	.000600	.94004	309.3	36.2	.000508	.93700	307.2	34.4	.000482
30	.93333	310.2	72.1	.001016	.93944	310.5	64.4	.000905	.94289	309.9	51.8	.000726
31	.94374	344.8	297.1	.004187	.94335	350.1	241.8	.003395	.93896	341.1	233.1	.003265
32	.93295	322.0	187.7	.002645	.93071	320.5	173.9	.002442	.92477	316.8	145.9	.002044
33	.93183	316.0	125.0	.001761	.92831	313.3	110.0	.001545	.92107	308.8	88.5	.001239
34	.93138	313.5	96.5	.001360	.92801	310.7	82.4	.001157	.92024	306.1	65.5	.000917
35	.92981	312.0	87.6	.001234	.92583	308.8	73.5	.001031	.91790	304.2	57.7	.000809
36	.92883	308.9	63.5	.000894	.92560	305.7	51.5	.000723	.91752	300.8	37.9	.000531
37	.95452	353.1	364.2	.005132	.95237	356.8	287.3	.004033	.94795	348.1	265.0	.003711
38	.94599	326.2	191.5	.002699	.94139	324.0	180.9	.002540	.93413	319.9	151.4	.002120
39	.94464	321.3	141.0	.001987	.94004	318.7	130.1	.001827	.93202	314.1	106.9	.001497
40	.94239	317.7	108.1	.001523	.93696	314.3	95.3	.001338	.92900	309.8	77.2	.001081
41	.94194	315.8	90.6	.001276	.93673	312.4	79.0	.001109	.92854	307.7	62.5	.000875
42	.94149	312.9	65.1	.000917	.93673	309.2	54.7	.000768	.92854	304.4	41.3	.000578
43	.96951	359.8	390.2	.005499	.96697	363.7	322.2	.004523	.96078	354.1	298.1	.004175
44	.95228	326.4	167.5	.002360	.94809	324.2	158.3	.002222	.94017	319.9	133.7	.001873
45	.94973	319.4	97.9	.001380	.94463	316.3	88.1	.001237	.93639	311.6	72.5	.001015
46	.94823	316.9	82.0	.001155	.94290	313.5	72.3	.001015	.93488	308.9	58.8	.000824
47	.94718	314.2	62.1	.000875	.94139	310.3	54.3	.000763	.93428	307.7	42.0	.000589
48	.97535	349.8	360.6	.005082	.97283	349.1	338.0	.004746	.96645	346.7	282.2	.003953
49	.96007	319.9	58.5	.000824	.95478	316.6	56.8	.000798	.94682	313.3	54.8	.000768
50	.96306	334.4	109.8	.001547	.95704	324.8	111.9	.001571	.94946	318.7	81.2	.001136
51	.96344	336.6	225.1	.003172	.96155	332.6	178.1	.002500	.95799	327.0	122.2	.001712
52	.95295	325.2	154.3	.002174	.94711	322.2	144.6	.002030	.94002	318.0	121.2	.001697
53	.95160	320.8	113.9	.001605	.94606	321.0	103.9	.001459	.93836	312.9	85.3	.001195
54	.95093	317.9	87.0	.001226	.94530	314.5	77.8	.001092	.93760	310.0	63.1	.000884
55	.95153	316.1	68.4	.000964	.94576	312.5	60.4	.000848	.93866	308.4	48.6	.000680
56	.97875	348.6	349.2	.004921	.97599	347.9	331.1	.004648	.96977	345.6	291.4	.003941
57	.95430	324.6	146.2	.002060	.94922	326.2	137.4	.001929	.94183	317.4	112.9	.001581
58	.95333	319.4	94.9	.001337	.94786	319.2	85.7	.001203	.94047	314.3	68.9	.000965
59	.95408	318.2	77.7	.001094	.94914	315.1	69.4	.000974	.94191	311.0	57.8	.000810
60	.98005	348.4	319.2	.004499	.97780	347.5	299.6	.004207	.97113	344.9	256.2	.003587
61	.95730	326.9	157.8	.002223	.95207	323.7	145.0	.002035	.94440	319.2	119.4	.001673
62	.95602	321.7	106.4	.001500	.95012	321.6	96.3	.001352	.94244	316.6	77.7	.001089
63	.95430	319.7	91.7	.001292	.94922	316.3	80.9	.001136	.94093	311.3	62.8	.000879
64	.95123	319.2	85.9	.001210	.94561	315.4	76.5	.001074	.93760	310.5	60.7	.000850
65	.96089	327.9	131.0	.001845	.95802	325.1	123.1	.001729	.95255	320.2	92.4	.001294
66	.98494	352.3	359.3	.005064	.98286	351.4	339.3	.004764	.97657	349.0	286.0	.004005
67	.98293	351.0	349.9	.004930	.98013	349.9	329.2	.004622	.97385	347.1	277.7	.003889
68	.98163	348.1	310.5	.004376	.97915	347.1	294.6	.004136	.97264	344.2	250.0	.003501
69	.96359	331.9	164.8	.002322	.96110	330.3	152.1	.002135	.95550	327.3	129.4	.001812
70	.97055	332.5	160.3	.002258	.96772	330.6	149.8	.002103	.96177	327.7	128.6	.001800
71	.97198	331.6	134.9	.001901	.97178	330.6	125.7	.001764	.97030	330.1	112.8	.001580

[a] h measured in J/m^2-sec-$^\circ$K

TABLE II.- TABULATION OF HEAT-TRANSFER MEASUREMENTS ON CLEAN MODEL AT A NOMINAL REYNOLDS NUMBER BASED ON MODEL LENGTH OF 3.0×10^6 - Concluded

(l) $\alpha = 40^\circ$ - Concluded

Thermo-couple	$\beta = 5^\circ$; $T_w = 389^\circ$ K; $p_t = 279.3$ kN/m^2				$\beta = 10^\circ$; $T_w = 388^\circ$ K; $p_t = 277.5$ kN/m^2							
	$\frac{T_e}{T_t}$	T_w, °K	h (a)	N_{St}	$\frac{T_e}{T_t}$	T_w, °K	h (a)	N_{St}	$\frac{T_e}{T_t}$	T_w, °K	h (a)	N_{St}
1	.94455	348.4	272.0	.003811	.94001	340.6	315.5	.004420				
2	.97486	366.7	375.0	.005255	.96975	359.2	450.8	.006317				
3	.98608	371.9	390.0	.005464	.98036	373.0	414.8	.005811				
4	.98920	371.1	353.9	.004958	.98393	361.9	384.8	.005391				
5	.99072	360.4	324.7	.004549	.98537	359.8	345.2	.004836				
6	.99311	361.1	312.2	.004374	.98769	360.3	329.2	.004613				
7	.99565	364.3	363.7	.005096	.99008	363.3	385.4	.005400				
8	.99376	365.5	395.2	.005538	.98813	364.5	424.5	.005947				
9	.98956	360.3	349.9	.004903	.98436	359.5	368.0	.005155				
10	.98564	348.1	219.9	.003082	.97969	347.5	227.4	.003187				
11	.98006	341.7	173.7	.002434	.97532	341.2	175.8	.002463				
12	.97968	338.9	152.2	.002132	.97554	338.5	152.8	.002141				
13	.92427	323.1	181.1	.002538	.92013	323.4	189.0	.002647				
14	.90708	303.5	68.1	.000955	.90447	301.0	72.0	.001009				
15	.90625	295.3	22.2	.000311	.90613	295.3	22.1	.000310				
16	.91379	297.5	19.6	.000275	.91606	298.4	18.2	.000254				
17	.93822	305.4	21.4	.000300	.93572	305.4	21.5	.000302				
18	.93468	304.4	22.3	.000312	.92269	302.6	27.3	.000382				
19	.95872	311.5	20.6	.000288	.94919	309.5	20.4	.000286				
20	.91228	297.0	24.3	.000340	.91305	298.4	26.3	.000368				
21	.92706	300.4	18.2	.000256	.92254	300.2	20.7	.000291				
22	.92955	300.9	15.9	.000223	.92118	300.1	20.5	.000288				
23	.95262	309.5	21.3	.000298	.93730	306.1	24.7	.000346				
24	.91726	313.8	141.6	.001984	.91253	312.7	141.3	.001980				
25	.90912	305.4	81.5	.001142	.90552	304.4	81.4	.001140				
26	.90482	296.2	37.7	.000529	.90327	295.8	35.3	.000495				
27	.90701	295.6	27.2	.000381	.90673	295.9	26.5	.000371				
28	.92050	298.9	22.5	.000315	.91652	298.3	22.4	.000314				
29	.92585	301.2	23.8	.000334	.92224	300.4	21.3	.000298				
30	.94267	308.9	41.4	.000580	.93745	306.7	31.0	.000435				
31	.93430	339.8	221.3	.003100	.92751	337.2	219.8	.003079				
32	.91922	313.6	130.3	.001825	.91245	310.7	122.3	.001714				
33	.91522	305.6	75.5	.001058	.90899	302.6	66.2	.000928				
34	.91477	303.4	55.5	.000778	.90929	300.9	47.7	.000668				
35	.91259	301.7	48.6	.000681	.90703	299.3	41.3	.000579				
36	.91289	298.6	30.9	.000432	.90808	296.6	25.7	.000360				
37	.94161	346.2	250.2	.003506	.93240	344.9	236.3	.003310				
38	.92661	316.0	133.8	.001875	.91757	312.3	124.4	.001744				
39	.92450	310.5	92.7	.001299	.91554	306.7	83.5	.001170				
40	.92148	306.3	65.8	.000922	.91290	302.8	56.4	.000791				
41	.92133	304.6	53.1	.000744	.91328	301.2	43.9	.000615				
42	.92193	301.5	32.8	.000460	.91501	298.8	27.7	.000388				
43	.95345	351.9	277.7	.003891	.94392	339.6	274.5	.003846				
44	.93241	316.1	117.5	.001646	.92269	312.3	110.7	.001551				
45	.92827	308.1	61.4	.000860	.91862	304.2	53.8	.000753				
46	.92683	305.6	48.9	.000686	.91757	302.1	41.3	.000579				
47	.92683	302.9	32.0	.000449	.91832	301.1	28.5	.000400				
48	.95918	343.5	264.4	.003705	.94949	339.8	257.8	.003612				
49	.94214	312.0	50.9	.000713	.93383	308.1	40.2	.000563				
50	.94018	311.3	49.6	.000694	.92736	302.6	24.2	.000339				
51	.95307	321.1	83.2	.001166	.94407	313.5	49.9	.000699				
52	.93158	314.2	106.5	.001492	.92134	313.5	97.1	.001361				
53	.92993	309.2	67.9	.000952	.91983	305.3	59.8	.000838				
54	.92932	308.7	51.6	.000723	.91953	302.9	42.5	.000595				
55	.93083	305.4	38.9	.000545	.92149	302.2	36.1	.000505				
56	.96264	342.6	262.5	.003679	.95296	339.0	256.6	.003596				
57	.93339	317.3	97.4	.001365	.92329	312.7	87.9	.001231				
58	.93196	308.0	53.6	.000752	.92194	306.1	48.5	.000680				
59	.93400	308.1	49.6	.000695	.92480	305.0	44.9	.000629				
60	.96400	341.9	237.2	.003323	.95446	338.3	230.7	.003232				
61	.93626	315.4	99.6	.001395	.92600	311.1	93.6	.001312				
62	.93370	312.4	64.4	.000902	.92329	307.9	56.4	.000790				
63	.93158	307.2	50.9	.000713	.92118	302.7	37.8	.000530				
64	.92706	306.0	48.8	.000684	.91576	301.2	39.6	.000554				
65	.94440	314.5	67.7	.000948	.93293	307.5	44.3	.000621				
66	.96913	346.0	265.8	.003724	.95928	342.2	258.9	.003627				
67	.96649	344.0	255.0	.003573	.95642	340.0	247.7	.003470				
68	.96536	341.2	229.8	.003219	.95574	337.3	221.6	.003104				
69	.94802	324.3	118.5	.001661	.93805	320.5	110.5	.001548				
70	.95631	326.1	117.1	.001641	.94889	325.2	118.0	.001653				
71	.96732	333.3	129.6	.001816	.96034	330.7	129.3	.001812				

[a] h measured in J/m^2-sec-°K

TABLE III.- TABULATION OF HEAT-TRANSFER MEASUREMENTS ON CLEAN MODEL AT A NOMINAL REYNOLDS NUMBER BASED ON MODEL LENGTH OF 4.5×10^6

(a) $\alpha = 0^{\circ}$

Thermocouple	$\beta = 0^{\circ}$; $T_w = 390^{\circ}$ K; $p_t = 462.1$ kN/m^2											
	$\frac{T_e}{T_t}$	T_w, $^{\circ}$K	h (a)	N_{St}	$\frac{T_e}{T_t}$	T_w, $^{\circ}$K	h (a)	N_{St}	$\frac{T_e}{T_t}$	T_w, $^{\circ}$K	h (a)	N_{St}
1	.98114	374.7	698.0	.005916								
2	.98271	373.8	671.8	.005693								
3	.98185	371.0	581.8	.004931								
4	.97900	365.8	477.9	.004051								
5	.97657	360.7	397.3	.003367								
6	.97699	360.8	377.0	.003195								
7	.96808	356.5	377.5	.003200								
8	.94356	342.4	311.1	.002637								
9	.92700	326.2	201.6	.001709								
10	.92856	314.2	75.4	.000639								
11	.93108	312.6	55.4	.000469								
12	.93413	312.6	49.4	.000419								
13	.96585	366.1	557.6	.004726								
14	.93093	335.1	263.3	.002231								
15	.92068	316.8	90.0	.000763								
16	.91860	307.1	32.8	.000278								
17	.94044	317.4	55.9	.000474								
18	.94594	324.1	91.2	.000773								
19	.94572	322.2	84.0	.000712								
20	.91771	308.1	48.7	.000413								
21	.92915	308.4	36.4	.000309								
22	.92722	308.3	42.6	.000361								
23	.92618	307.7	39.0	.000331								
24	.95114	353.4	425.9	.003609								
25	.93435	336.0	284.3	.002410								
26	.92573	319.9	137.8	.001168								
27	.91979	312.4	83.9	.000711								
28	.92662	313.8	70.1	.000594								
29	.92558	319.4	118.8	.001007								
30	.92046	317.7	120.0	.001017								
31	.96778	366.4	570.4	.004835								
32	.94074	339.8	290.8	.002465								
33	.93242	328.2	148.0	.001254								
34	.92885	319.0	110.1	.000933								
35	.92544	316.6	99.4	.000842								
36	.92484	314.3	82.4	.000698								
37	.96139	361.4	510.1	.004323								
38	.93762	337.7	222.3	.001884								
39	.93509	329.3	149.6	.001268								
40	.93123	319.0	110.5	.000936								
41	.93012	316.8	94.2	.000798								
42	.93093	315.7	81.8	.000693								
43	.95842	355.6	432.7	.003667								
44	.93762	333.2	175.5	.001487								
45	.93420	323.1	98.8	.000838								
46	.93272	317.2	89.9	.000762								
47	.93383	317.8	86.1	.000730								
48	.95753	352.8	381.6	.003234								
49	.95069	329.6	119.5	.001013								
50	.94520	333.7	194.4	.001647								
51	.94312	331.5	173.3	.001468								
52	.93450	329.9	157.3	.001333								
53	.93383	323.6	113.0	.000958								
54	.93383	318.3	99.2	.000841								
55	.93680	320.7	93.3	.000791								
56	.95812	349.7	357.9	.003033								
57	.93450	329.0	151.2	.001282								
58	.93361	319.7	101.8	.000863								
59	.94223	326.0	91.5	.000775								
60	.95827	348.5	319.6	.002708								
61	.92960	323.6	156.5	.001326								
62	.93405	321.2	110.4	.000936								
63	.94787	330.5	141.7	.001201								
64	.94505	333.6	193.5	.001640								
65	.94416	332.1	175.4	.001486								
66	.95010	345.1	311.3	.002639								
67	.93546	334.3	247.2	.002095								
68	.92737	325.7	189.1	.001603								
69	.92974	313.5	65.5	.000555								
70	.93346	312.5	49.5	.000420								
71	.93985	316.7	40.9	.000347								

[a] h measured in J/m^2-sec-$^{\circ}$K

TABLE III.- TABULATION OF HEAT-TRANSFER MEASUREMENTS ON CLEAN MODEL AT A NOMINAL REYNOLDS NUMBER BASED ON MODEL LENGTH OF 4.5×10^6 - Continued

(b) $\alpha = 10^{\circ}$

Thermocouple	$\beta = 0^{\circ}$; $T_w = 386^{\circ}$ K; $p_t = 462.1$ kN/m^2											
	$\frac{T_e}{T_t}$	T_w, $^{\circ}$K	h (a)	N_{St}	$\frac{T_e}{T_t}$	T_w, $^{\circ}$K	h (a)	N_{St}	$\frac{T_e}{T_t}$	T_w, $^{\circ}$K	h (a)	N_{St}
1	.97828	362.9	623.1	.005248								
2	.98815	367.4	679.5	.005723								
3	.98942	365.6	586.7	.004941								
4	.98857	361.3	476.9	.004016								
5	.98773	357.6	401.2	.003379								
6	.98801	357.8	384.7	.003240								
7	.98068	354.7	396.6	.003341								
8	.96220	345.0	347.0	.002922								
9	.94744	333.2	244.1	.002056								
10	.94832	324.6	113.3	.000954								
11	.95352	325.3	97.5	.000821								
12	.95565	325.3	91.9	.000774								
13	.95867	351.1	459.2	.003868								
14	.92426	326.7	187.3	.001578								
15	.91590	312.0	55.0	.000463								
16	.92558	312.0	49.8	.000419								
17	.93270	315.6	61.0	.000514								
18	.93013	315.8	73.7	.000621								
19	.92998	315.3	70.7	.000596								
20	.91957	309.0	40.3	.000339								
21	.92060	308.5	33.1	.000279								
22	.90710	302.6	31.4	.000265								
23	.92001	307.1	30.4	.000256								
24	.94538	339.8	349.6	.002944								
25	.92910	329.1	214.2	.001804								
26	.91986	316.5	102.1	.000860								
27	.91268	309.1	58.3	.000491								
28	.91429	308.2	46.2	.000389								
29	.90879	303.7	36.4	.000307								
30	.92338	310.5	38.1	.000321								
31	.96544	354.9	513.1	.004322								
32	.94010	331.8	252.2	.002124								
33	.93116	323.8	132.8	.001118								
34	.92661	316.4	101.6	.000856								
35	.92294	314.3	92.9	.000783								
36	.92148	312.4	77.2	.000651								
37	.96403	353.1	481.7	.004057								
38	.93996	332.7	200.0	.001685								
39	.93746	326.3	135.2	.001139								
40	.93336	321.5	104.3	.000878								
41	.93174	316.8	92.1	.000776								
42	.93013	315.3	80.0	.000674								
43	.96389	349.9	427.0	.003597								
44	.94157	330.4	163.7	.001378								
45	.93827	322.7	94.0	.000791								
46	.93666	323.2	87.6	.000738								
47	.93336	316.5	81.8	.000689								
48	.96544	348.5	380.0	.003201								
49	.93394	315.1	64.5	.000543								
50	.93746	313.5	38.7	.000326								
51	.95418	331.8	165.3	.001392								
52	.94025	328.6	149.5	.001259								
53	.93893	323.7	108.7	.000916								
54	.93805	321.3	90.8	.000765								
55	.93526	316.9	82.1	.000691								
56	.96763	346.7	355.9	.002997								
57	.94054	327.9	143.5	.001209								
58	.93761	322.5	101.0	.000850								
59	.93629	317.5	83.0	.000699								
60	.96756	345.6	316.9	.002669								
61	.93644	326.1	140.8	.001186								
62	.93512	320.1	85.4	.000719								
63	.93776	316.3	64.2	.000541								
64	.95521	329.5	129.9	.001094								
65	.95558	332.2	174.8	.001472								
66	.96149	343.3	316.1	.002662								
67	.95022	335.5	258.8	.002180								
68	.94289	329.4	207.3	.001746								
69	.94252	321.0	92.1	.000776								
70	.95506	324.5	76.4	.000644								
71	.95860	337.9	221.3	.001964								

[a] h measured in J/m^2-sec-$^{\circ}$K

TABLE III.- TABULATION OF HEAT-TRANSFER MEASUREMENTS ON CLEAN MODEL AT A NOMINAL REYNOLDS NUMBER BASED ON MODEL LENGTH OF 4.5×10^6 - Concluded

(c) $\alpha = 20^\circ$

Thermocouple	$\beta = 0^\circ$; $T_w = 387^\circ$ K; $p_t = 462.1$ kN/m^2											
	$\frac{T_e}{T_t}$	T_w, $^\circ$K	h (a)	N_{St}	$\frac{T_e}{T_t}$	T_w, $^\circ$K	h (a)	N_{St}	$\frac{T_e}{T_t}$	T_w, $^\circ$K	h (a)	N_{St}
1	.96757	361.2	649.0	.005479								
2	.98553	371.2	844.4	.007129								
3	.99026	371.3	747.5	.006310								
4	.99097	367.6	584.5	.004934								
5	.99097	364.0	483.3	.004080								
6	.99183	364.3	462.0	.003900								
7	.98811	363.5	499.5	.004216								
8	.97578	357.6	476.9	.004026								
9	.96236	346.6	363.1	.003065								
10	.96579	337.2	194.3	.001641								
11	.96638	334.4	158.1	.001334								
12	.96281	331.2	140.0	.001182								
13	.94478	346.2	424.4	.003583								
14	.91453	319.8	163.5	.001381								
15	.90946	306.7	54.3	.000459								
16	.92108	309.8	60.0	.000507								
17	.91810	307.2	55.2	.000466								
18	.92302	307.4	45.1	.000381								
19	.92839	308.2	41.5	.000351								
20	.91796	306.7	51.4	.000434								
21	.91863	303.5	28.5	.000241								
22	.92019	303.5	26.5	.000224								
23	.92108	302.8	21.9	.000185								
24	.93405	335.5	326.8	.002759								
25	.91930	319.0	200.5	.001693								
26	.91051	310.2	95.5	.000807								
27	.90872	304.8	59.2	.000500								
28	.90887	300.2	38.9	.000329								
29	.92094	307.7	65.7	.000554								
30	.91840	306.0	62.9	.000531								
31	.95573	353.6	530.9	.004482								
32	.93315	330.9	267.9	.002262								
33	.92555	318.2	148.8	.001256								
34	.92228	314.1	109.2	.000922								
35	.91915	312.0	99.0	.000836								
36	.91676	309.0	81.1	.000684								
37	.95886	355.3	542.0	.004576								
38	.93643	328.5	236.0	.001992								
39	.93464	331.3	169.7	.001433								
40	.93092	317.5	121.6	.001027								
41	.92943	315.1	103.3	.000872								
42	.92704	312.7	86.5	.000731								
43	.96296	354.7	510.2	.004307								
44	.94046	337.5	207.5	.001752								
45	.93680	322.5	110.4	.000932								
46	.93464	316.2	98.1	.000829								
47	.93107	313.6	85.3	.000720								
48	.96653	354.0	459.8	.003882								
49	.93479	311.4	56.3	.000475								
50	.95595	333.9	199.5	.001684								
51	.95163	330.6	175.6	.001482								
52	.93956	335.1	188.7	.001593								
53	.93792	324.0	130.3	.001100								
54	.93643	317.2	106.7	.000901								
55	.93345	314.3	85.6	.000723								
56	.96951	352.1	428.6	.003618								
57	.94016	333.7	176.3	.001488								
58	.93688	318.4	116.3	.000982								
59	.93599	317.5	81.9	.000691								
60	.96966	350.6	377.6	.003188								
61	.93822	323.4	165.5	.001397								
62	.93748	317.4	96.1	.000811								
63	.94686	321.3	92.8	.000784								
64	.95640	335.2	219.5	.001853								
65	.94925	333.6	218.3	.001843								
66	.96743	350.5	392.0	.003309								
67	.95908	344.5	342.0	.002887								
68	.95342	338.6	281.8	.002379								
69	.95483	329.7	142.6	.001204								
70	.96370	342.9	166.8	.001408								
71	.95655	334.0	173.0	.001461								

[a] h measured in J/m^2-sec-$^\circ$K

TABLE IV.- TABULATION OF HEAT-TRANSFER MEASUREMENTS ON MODEL WITH ROUGHNESS AT A NOMINAL REYNOLDS NUMBER BASED ON MODEL LENGTH OF 3.0×10^6

(a) $\alpha = 0^\circ$

Thermocouple	$\beta = 0^\circ$; $T_w = 387^\circ$ K; $p_t = 279.5$ kN/m^2											
	$\frac{T_e}{T_t}$	T_w, $^\circ$K	h (a)	N_{St}	$\frac{T_e}{T_t}$	T_w, $^\circ$K	h (a)	N_{St}	$\frac{T_e}{T_t}$	T_w, $^\circ$K	h (a)	N_{St}
1	.98007	363.0	538.0	.007510								
2	.98234	361.9	522.1	.007288								
3	.98249	359.8	478.5	.006680								
4	.98052	362.3	514.2	.007178								
5	.97825	355.2	417.5	.005829								
6	.98098	355.2	387.9	.005415								
7	.97182	349.4	356.5	.004976								
8	.94905	334.0	270.8	.003780								
9	.93929	326.6	177.8	.002482								
10	.94784	323.0	146.7	.002048								
11	.94761	321.0	125.8	.001756								
12	.94784	320.6	122.3	.001707								
13	.96622	354.2	431.0	.006017								
14	.93649	325.0	204.3	.002852								
15	.93618	316.8	76.4	.001066								
16	.93997	309.3	38.0	.000531								
17	.95011	313.7	59.0	.000823								
18	.94829	312.7	55.0	.000767								
19	.95071	312.2	49.8	.000695								
20	.93966	310.4	67.1	.000936								
21	.93391	306.0	40.8	.000569								
22	.92620	302.0	32.0	.000447								
23	.92544	300.9	26.2	.000366								
24	.95313	341.4	331.4	.004626								
25	.93989	325.3	216.9	.003028								
26	.94693	321.1	130.6	.001824								
27	.93649	315.1	111.2	.001553								
28	.93013	310.0	84.6	.001181								
29	.92635	308.2	79.7	.001112								
30	.92340	307.1	80.1	.001118								
31	.96811	354.0	435.6	.006081								
32	.94663	329.2	224.0	.003127								
33	.95412	328.1	172.6	.002410								
34	.94632	326.5	170.6	.002382								
35	.94254	322.9	152.9	.002134								
36	.94209	320.2	130.9	.001827								
37	.96168	348.3	392.3	.005476								
38	.95291	335.4	208.4	.002909								
39	.95109	330.6	200.8	.002803								
40	.94723	326.0	174.0	.002429								
41	.94859	324.3	157.2	.002195								
42	.94905	323.7	146.2	.002040								
43	.96395	347.1	373.8	.005219								
44	.94663	327.7	205.8	.002873								
45	.94799	322.1	133.0	.001857								
46	.95109	324.6	143.9	.002009								
47	.94980	325.2	155.9	.002177								
48	.96297	351.4	422.2	.005894								
49	.95064	323.9	145.3	.002029								
50	.94708	319.9	122.2	.001706								
51	.94557	319.0	114.8	.001603								
52	.93997	330.6	165.9	.002317								
53	.94345	322.2	120.3	.001680								
54	.94708	320.7	129.0	.001801								
55	.95041	322.9	139.2	.001943								
56	.96259	346.8	392.0	.005473								
57	.93830	324.1	152.9	.002135								
58	.94254	320.8	110.1	.001536								
59	.94935	324.0	142.6	.001991								
60	.96146	351.8	432.8	.006042								
61	.93240	316.9	148.4	.002071								
62	.93694	314.1	101.8	.001421								
63	.94958	321.9	122.3	.001708								
64	.94791	321.1	131.1	.001830								
65	.94693	320.0	119.1	.001663								
66	.95419	346.1	370.9	.005178								
67	.94375	335.9	282.8	.003948								
68	.93861	326.8	209.9	.002929								
69	.93770	317.2	111.3	.001554								
70	.94655	320.0	126.1	.001760								
71	.94708	319.8	117.0	.001633								

[a] h measured in J/m^2-sec-$^\circ$K

TABLE IV.- TABULATION OF HEAT-TRANSFER MEASUREMENTS ON MODEL WITH ROUGHNESS AT A NOMINAL REYNOLDS NUMBER BASED ON MODEL LENGTH OF 3.0×10^6 - Continued

(b) $\alpha = 5^{\circ}$

Thermocouple	$\beta = 0^{\circ}$; $T_w = 387^{\circ}$ K; $p_t = 280.4$ kN/m^2											
	$\frac{T_e}{T_t}$	T_w, $^{\circ}$K	h (a)	N_{St}	$\frac{T_e}{T_t}$	T_w, $^{\circ}$K	h (a)	N_{St}	$\frac{T_e}{T_t}$	T_w, $^{\circ}$K	h (a)	N_{St}
1	.97823	361.4	575.3	.008007								
2	.98452	363.1	584.6	.008137								
3	.98527	361.5	534.5	.007439								
4	.98459	362.2	533.2	.007421								
5	.98300	354.5	405.0	.005637								
6	.98376	352.8	361.9	.005037								
7	.97398	347.8	354.1	.004929								
8	.95450	336.2	294.0	.004092								
9	.94670	326.2	217.3	.003024								
10	.95337	327.4	181.6	.002528								
11	.95306	326.4	166.0	.002310								
12	.95299	326.1	166.6	.002318								
13	.96178	350.7	432.7	.006023								
14	.93245	320.7	186.9	.002601								
15	.93222	308.7	57.5	.000801								
16	.93184	305.4	33.7	.000469								
17	.93760	309.4	61.9	.000862								
18	.93351	307.4	54.5	.000758								
19	.93836	307.4	46.2	.000642								
20	.92942	304.9	44.5	.000619								
21	.92866	303.3	35.8	.000498								
22	.92972	302.0	27.9	.000389								
23	.93336	302.6	24.7	.000344								
24	.94927	338.2	326.1	.004539								
25	.93639	322.1	205.4	.002858								
26	.94374	319.1	128.5	.001788								
27	.92745	308.7	92.4	.001287								
28	.92783	306.4	70.9	.000986								
29	.92722	305.0	61.1	.000851								
30	.92593	304.5	62.0	.000863								
31	.96595	352.5	457.9	.006374								
32	.94518	328.3	231.1	.003217								
33	.95367	329.9	192.9	.002684								
34	.94048	323.3	169.5	.002359								
35	.93760	319.9	146.3	.002037								
36	.93813	317.7	125.0	.001740								
37	.96201	348.5	422.0	.005874								
38	.95299	336.3	231.6	.003224								
39	.95064	331.9	228.6	.003182								
40	.94442	324.0	170.7	.002376								
41	.94488	321.8	144.7	.002014								
42	.94685	321.5	132.7	.001847								
43	.96504	347.9	406.8	.005662								
44	.94647	328.0	217.5	.003027								
45	.94427	318.4	120.3	.001675								
46	.94579	317.7	107.9	.001502								
47	.94738	319.7	118.8	.001654								
48	.96473	352.0	457.8	.006372								
49	.95094	322.9	140.0	.001949								
50	.94852	319.6	122.8	.001709								
51	.94730	318.8	115.1	.001601								
52	.94079	325.0	164.0	.002282								
53	.94063	318.9	115.9	.001614								
54	.94200	314.4	99.9	.001390								
55	.94776	317.7	101.0	.001405								
56	.96610	347.4	399.9	.005566								
57	.93935	324.2	161.3	.002245								
58	.93957	314.6	108.2	.001506								
59	.94609	319.3	111.3	.001549								
60	.96473	352.5	455.6	.006341								
61	.93359	316.3	149.0	.002074								
62	.93556	314.0	87.5	.001219								
63	.94715	312.8	67.9	.000945								
64	.95049	320.5	117.2	.001632								
65	.95079	321.2	127.7	.001777								
66	.95791	346.6	395.1	.005500								
67	.94867	338.0	310.0	.004315								
68	.94442	329.7	235.3	.003276								
69	.94018	320.1	141.4	.001967								
70	.94943	322.9	151.2	.002104								
71	.95049	323.2	144.5	.002011								

[a] h measured in J/m^2-sec-$^{\circ}$K

TABLE IV.- TABULATION OF HEAT-TRANSFER MEASUREMENTS ON MODEL WITH ROUGHNESS AT A NOMINAL REYNOLDS NUMBER BASED ON MODEL LENGTH OF 3.0×10^6 - Continued

(c) $\alpha = 10^o$

Thermocouple	$\beta = 0^o$; $T_w = 390^o$ K; $p_t = 279.5$ kN/m^2											
	$\frac{T_e}{T_t}$	T_w, ^oK	h (a)	N_{St}	$\frac{T_e}{T_t}$	T_w, ^oK	h (a)	N_{St}	$\frac{T_e}{T_t}$	T_w, ^oK	h (a)	N_{St}
1	.97549	373.0	440.0	.006169								
2	.98571	364.2	527.2	.007393								
3	.98753	363.0	487.7	.006838								
4	.98813	362.0	446.5	.006260								
5	.98601	354.7	358.9	.005032								
6	.98662	354.1	336.0	.004712								
7	.97897	350.8	343.8	.004821								
8	.96224	341.1	302.2	.004237								
9	.95391	332.2	241.1	.003381								
10	.95951	333.4	210.8	.002956								
11	.95845	332.6	201.8	.002829								
12	.95709	332.3	205.3	.002879								
13	.95709	347.4	365.3	.005123								
14	.92847	317.1	157.1	.002203								
15	.92726	305.3	44.7	.000626								
16	.92938	304.4	39.8	.000559								
17	.92779	304.3	44.2	.000620								
18	.93119	305.7	44.3	.000621								
19	.93278	305.8	45.3	.000635								
20	.92612	303.0	38.7	.000543								
21	.92272	299.6	30.9	.000434								
22	.92605	299.2	22.1	.000310								
23	.92673	300.2	21.5	.000301								
24	.94543	335.2	282.5	.003961								
25	.93278	319.1	178.2	.002499								
26	.93740	315.5	112.7	.001580								
27	.92325	305.4	71.6	.001004								
28	.92438	303.0	50.9	.000714								
29	.92635	303.5	51.3	.000719								
30	.92408	302.4	50.2	.000704								
31	.96375	350.9	401.9	.005635								
32	.94301	327.4	215.2	.003017								
33	.94846	329.5	186.2	.002610								
34	.93733	320.8	141.7	.001986								
35	.93437	316.7	115.8	.001624								
36	.93377	312.9	91.2	.001279								
37	.96148	348.6	386.7	.005422								
38	.95217	330.0	215.2	.003018								
39	.94982	330.6	199.5	.002797								
40	.94255	320.8	139.5	.001956								
41	.94119	316.6	109.3	.001532								
42	.94089	316.2	96.6	.001354								
43	.96595	348.4	374.0	.005244								
44	.94770	326.8	193.3	.002711								
45	.94323	316.6	104.0	.001458								
46	.94195	314.4	91.7	.001285								
47	.94104	314.5	89.3	.001252								
48	.96776	350.9	382.7	.005366								
49	.94732	316.0	73.1	.001025								
50	.95073	318.9	94.1	.001320								
51	.95058	320.4	114.9	.001611								
52	.94164	325.5	155.5	.002181								
53	.94020	319.0	110.4	.001548								
54	.93892	312.6	91.7	.001286								
55	.93884	311.3	77.7	.001090								
56	.96814	348.4	364.7	.005114								
57	.94051	324.3	150.1	.002104								
58	.93710	312.8	98.2	.001377								
59	.93710	311.2	76.5	.001073								
60	.96784	352.2	387.5	.005433								
61	.93528	316.8	141.4	.001982								
62	.93657	313.7	79.1	.001109								
63	.95179	316.7	76.7	.001076								
64	.95376	322.5	129.3	.001813								
65	.95285	321.4	117.0	.001641								
66	.96330	348.7	366.6	.005141								
67	.95345	341.4	308.0	.004319								
68	.94967	334.0	248.3	.003482								
69	.94263	323.3	155.7	.002183								
70	.95209	326.7	171.6	.002406								
71	.95255	326.9	166.0	.002327								

[a] h measured in J/m^2-sec-^{o}K

TABLE IV.- TABULATION OF HEAT-TRANSFER MEASUREMENTS ON MODEL WITH ROUGHNESS AT A NOMINAL REYNOLDS NUMBER BASED ON MODEL LENGTH OF 3.0×10^6 - Continued

(d) $\alpha = 15^{o}$

Thermocouple	$\beta = 0^{o}$; $T_w = 389^{o}$ K; $p_t = 279.9$ kN/m^2											
	$\frac{T_e}{T_t}$	T_w, ^{o}K	h (a)	N_{St}	$\frac{T_e}{T_t}$	T_w, ^{o}K	h (a)	N_{St}	$\frac{T_e}{T_t}$	T_w, ^{o}K	h (a)	N_{St}
1	.97027	357.1	464.7	.006492								
2	.98411	364.2	527.2	.007365								
3	.98749	363.6	486.2	.006791								
4	.98887	361.2	423.9	.005921								
5	.98764	355.8	355.2	.004961								
6	.98844	355.4	334.0	.004666								
7	.98229	353.2	353.0	.004931								
8	.96823	345.7	326.8	.004565								
9	.95991	337.4	272.5	.003806								
10	.96452	339.4	255.4	.003567								
11	.96248	338.7	249.6	.003487								
12	.95507	337.0	265.6	.003711								
13	.95068	343.2	331.5	.004631								
14	.92376	313.5	138.1	.001930								
15	.92210	305.4	42.4	.000592								
16	.92542	305.4	47.9	.000669								
17	.92875	304.2	40.4	.000564								
18	.92648	303.5	37.7	.000526								
19	.93329	304.6	34.2	.000478								
20	.92225	300.8	38.2	.000534								
21	.92565	301.7	22.0	.000308								
22	.92754	299.9	20.8	.000291								
23	.93102	300.4	18.2	.000254								
24	.94025	331.9	258.9	.003617								
25	.92845	316.2	161.8	.002259								
26	.93011	311.6	102.2	.001427								
27	.91620	301.3	57.1	.000798								
28	.91877	299.1	33.3	.000465								
29	.92746	302.4	37.2	.000519								
30	.92520	302.0	42.9	.000599								
31	.95915	348.6	380.4	.005313								
32	.94002	326.2	206.8	.002889								
33	.94531	328.0	177.8	.002484								
34	.93057	316.8	121.4	.001695								
35	.92497	309.4	89.9	.001256								
36	.92270	305.9	64.2	.000897								
37	.95900	347.9	379.8	.005305								
38	.95053	329.8	212.3	.002965								
39	.94675	328.9	186.8	.002610								
40	.93586	315.7	118.7	.001657								
41	.93314	311.8	89.7	.001254								
42	.93026	308.7	71.5	.000999								
43	.96497	348.6	371.3	.005187								
44	.94660	325.7	183.6	.002565								
45	.93926	314.5	96.2	.001343								
46	.93631	311.2	80.3	.001121								
47	.93253	309.1	71.2	.000995								
48	.96853	350.0	361.6	.005051								
49	.93954	309.3	52.0	.000726								
50	.95295	322.5	123.3	.001723								
51	.95129	319.7	103.1	.001441								
52	.94085	320.2	152.8	.002135								
53	.93866	314.6	100.5	.001404								
54	.93639	311.6	87.1	.001217								
55	.93435	309.4	71.6	.001000								
56	.96876	348.3	353.8	.004941								
57	.94070	319.5	139.2	.001944								
58	.93654	312.9	95.6	.001336								
59	.93571	309.9	70.5	.000984								
60	.96913	352.1	369.9	.005167								
61	.93692	317.6	140.5	.001962								
62	.93949	319.5	87.5	.001223								
63	.95643	326.0	134.9	.001884								
64	.95227	322.6	129.7	.001812								
65	.95083	322.2	125.6	.001754								
66	.96528	350.0	366.0	.005112								
67	.95673	343.9	321.6	.004493								
68	.95431	338.4	274.4	.003832								
69	.94463	326.6	173.9	.002430								
70	.95386	330.3	198.6	.002775								
71	.95083	330.3	203.1	.002837								

[a] h measured in J/m^2-sec-^{o}K

TABLE IV.- TABULATION OF HEAT-TRANSFER MEASUREMENTS ON MODEL WITH ROUGHNESS AT A NOMINAL REYNOLDS NUMBER BASED ON MODEL LENGTH OF 3.0×10^6 - Continued

(e) $\alpha = 20^{\circ}$

Thermocouple	$\beta = 0^{\circ}$; $T_w = 388^{\circ}$ K; $p_t = 279.5$ kN/m^2											
	$\frac{T_e}{T_t}$	T_w, $^{\circ}$K	h (a)	N_{St}	$\frac{T_e}{T_t}$	T_w, $^{\circ}$K	h (a)	N_{St}	$\frac{T_e}{T_t}$	T_w, $^{\circ}$K	h (a)	N_{St}
1	.96452	354.4	552.9	.007731								
2	.98236	364.4	695.4	.009724								
3	.98734	373.9	682.2	.009540								
4	.98894	361.5	521.1	.007286								
5	.98851	357.4	432.9	.006054								
6	.98953	357.0	408.9	.005718								
7	.98524	356.1	447.0	.006250								
8	.97351	350.4	428.3	.005989								
9	.96452	342.8	366.9	.005131								
10	.96883	345.6	362.1	.005064								
11	.96300	343.9	361.3	.005053								
12	.95136	341.3	397.0	.005551								
13	.94394	339.2	357.3	.004997								
14	.91959	314.8	137.3	.001919								
15	.91899	301.6	39.6	.000553								
16	.92194	304.1	47.8	.000668								
17	.92201	302.6	44.2	.000618								
18	.92867	303.5	36.4	.000509								
19	.93547	304.9	33.5	.000469								
20	.91982	301.6	42.2	.000589								
21	.92171	297.8	19.0	.000265								
22	.93063	300.3	18.1	.000252								
23	.93313	300.4	15.5	.000216								
24	.93547	378.8	273.1	.003819								
25	.92428	318.6	168.3	.002353								
26	.92723	310.0	104.4	.001460								
27	.91399	299.9	56.3	.000787								
28	.91437	298.2	30.6	.000428								
29	.92731	303.3	48.9	.000684								
30	.92428	303.1	43.4	.000607								
31	.95438	346.4	437.1	.006112								
32	.93699	325.2	228.4	.003194								
33	.94621	328.6	192.0	.002685								
34	.92927	315.2	124.0	.001734								
35	.92231	308.4	92.4	.001292								
36	.91838	303.9	68.3	.000955								
37	.95604	347.4	455.5	.006370								
38	.94909	330.2	242.7	.003393								
39	.94652	329.0	205.8	.002877								
40	.93472	315.0	125.3	.001752								
41	.93048	310.2	93.5	.001307								
42	.92738	308.0	75.3	.001053								
43	.96383	349.2	452.7	.006330								
44	.94591	325.9	205.6	.002875								
45	.93835	317.6	102.5	.001433								
46	.93494	311.0	85.6	.001197								
47	.93094	308.0	73.7	.001031								
48	.96830	350.4	430.9	.006026								
49	.94167	311.3	55.0	.000769								
50	.95347	321.5	124.9	.001747								
51	.94803	320.7	130.2	.001821								
52	.94062	325.4	168.8	.002360								
53	.93835	318.6	116.5	.001629								
54	.93585	311.5	93.7	.001310								
55	.93366	309.0	74.1	.001037								
56	.96951	349.0	414.3	.005793								
57	.94062	324.5	162.1	.002266								
58	.93668	312.9	102.5	.001433								
59	.93653	312.0	71.2	.000996								
60	.96996	352.0	431.5	.006033								
61	.93857	323.5	159.4	.002229								
62	.94258	315.7	109.7	.001534								
63	.95604	327.1	165.1	.002308								
64	.95075	323.0	150.4	.002102								
65	.94500	322.2	157.0	.002196								
66	.96830	351.2	440.1	.006154								
67	.96073	347.3	411.4	.005753								
68	.95816	343.1	365.6	.005113								
69	.94689	330.2	222.8	.003115								
70	.95347	334.0	269.9	.003774								
71	.94682	333.2	281.0	.003929								

[a] h measured in J/m^2-sec-$^{\circ}$K

TABLE IV.- TABULATION OF HEAT-TRANSFER MEASUREMENTS ON MODEL WITH ROUGHNESS AT A NOMINAL REYNOLDS NUMBER BASED ON MODEL LENGTH OF 3.0×10^6 - Continued

(f) $\alpha = 30^\circ$

Thermocouple	$\beta = 0^\circ$; $T_w = 388^\circ$ K; $p_t = 277.2$ kN/m^2											
	$\frac{T_e}{T_t}$	T_w, °K	h (a)	N_{St}	$\frac{T_e}{T_t}$	T_w, °K	h (a)	N_{St}	$\frac{T_e}{T_t}$	T_w, °K	h (a)	N_{St}
1	.95691	350.2	346.4	.004880								
2	.98147	371.6	446.6	.006291								
3	.98990	369.0	478.4	.006740								
4	.99236	366.0	412.1	.005806								
5	.99221	362.1	352.0	.004959								
6	.99351	362.4	339.9	.004788								
7	.99236	363.5	385.4	.005429								
8	.98558	361.6	404.0	.005692								
9	.97813	355.1	362.8	.005111								
10	.97952	358.8	401.9	.005662								
11	.96433	355.8	445.2	.006272								
12	.96351	354.4	430.5	.006066								
13	.93636	333.6	230.6	.003249								
14	.91701	311.6	92.5	.001303								
15	.91859	302.0	29.8	.000420								
16	.91791	303.4	33.6	.000473								
17	.92684	304.6	28.5	.000401								
18	.93659	307.7	27.3	.000385								
19	.93741	308.0	28.1	.000395								
20	.91836	303.9	32.9	.000463								
21	.92999	302.7	16.9	.000238								
22	.93689	304.3	14.2	.000200								
23	.94363	306.3	13.3	.000187								
24	.92961	324.4	187.2	.002638								
25	.92084	315.4	117.1	.001650								
26	.92316	311.1	74.2	.001045								
27	.91364	302.5	40.2	.000566								
28	.92721	304.1	32.3	.000455								
29	.92841	307.1	39.7	.000559								
30	.92361	305.1	47.9	.000675								
31	.94776	342.7	289.3	.004076								
32	.93336	323.9	172.8	.002434								
33	.93959	325.8	138.4	.001950								
34	.92751	313.3	86.6	.001220								
35	.92129	308.9	68.6	.000966								
36	.91836	305.2	51.0	.000719								
37	.95241	346.8	321.6	.004531								
38	.94731	331.9	199.4	.002809								
39	.94311	327.8	156.3	.002202								
40	.93359	315.6	94.9	.001336								
41	.92991	311.3	73.8	.001040								
42	.92796	308.8	56.1	.000790								
43	.96486	352.6	360.1	.005073								
44	.94641	328.0	169.7	.002390								
45	.93839	315.4	83.4	.001175								
46	.93464	312.2	68.8	.000969								
47	.93261	309.8	55.6	.000784								
48	.97108	354.0	340.4	.004795								
49	.95661	327.9	123.0	.001733								
50	.94851	325.1	128.5	.001810								
51	.93884	323.8	141.6	.001995								
52	.94116	326.2	134.4	.001894								
53	.93869	316.1	88.8	.001251								
54	.93621	313.4	75.6	.001066								
55	.93711	313.1	55.5	.000782								
56	.97100	349.3	310.8	.004379								
57	.94131	325.3	128.2	.001806								
58	.93831	314.7	78.9	.001112								
59	.94176	316.1	64.5	.000908								
60	.97115	350.7	295.0	.004156								
61	.94191	327.7	145.8	.002054								
62	.94476	321.5	113.1	.001593								
63	.94941	322.5	111.6	.001572								
64	.94026	320.8	124.1	.001748								
65	.93786	320.4	121.9	.001718								
66	.97385	354.6	339.2	.004779								
67	.96973	355.4	359.6	.005066								
68	.96823	352.8	338.9	.004775								
69	.94858	338.5	240.2	.003384								
70	.95151	342.2	309.3	.004358								
71	.95083	341.6	290.3	.004090								

[a] h measured in J/m^2-sec-°K

TABLE IV.- TABULATION OF HEAT-TRANSFER MEASUREMENTS ON MODEL WITH ROUGHNESS AT A NOMINAL REYNOLDS NUMBER BASED ON MODEL LENGTH OF 3.0×10^6 - Concluded

(g) $\alpha = 40^{\circ}$

Thermocouple	$\beta = 0^{\circ}$; $T_w = 389^{\circ}$ K; $p_t = 278.6$ kN/m^2											
	$\frac{T_e}{T_t}$	T_w, $^{\circ}$K	h (a)	N_{St}	$\frac{T_e}{T_t}$	T_w, $^{\circ}$K	h (a)	N_{St}	$\frac{T_e}{T_t}$	T_w, $^{\circ}$K	h (a)	N_{St}
1	.94911	339.5	311.4	.004373								
2	.98006	359.7	477.8	.006710								
3	.99292	368.1	550.1	.007725								
4	.99552	363.4	434.5	.006101								
5	.99596	359.2	356.5	.005006								
6	.99798	359.8	325.9	.004577								
7	1.00000	362.6	398.3	.005593								
8	.99805	380.0	380.2	.005338								
9	.99422	360.0	389.3	.005467								
10	.99075	355.6	328.3	.004611								
11	.98570	357.2	380.7	.005346								
12	.98498	357.1	392.8	.005516								
13	.92959	322.7	190.3	.002673								
14	.91427	305.2	64.3	.000903								
15	.91682	299.8	23.8	.000334								
16	.91787	299.6	19.9	.000279								
17	.92756	303.9	28.7	.000403								
18	.91930	300.4	23.7	.000333								
19	.94356	308.5	25.5	.000358								
20	.91712	300.2	21.0	.000296								
21	.93424	302.8	13.8	.000194								
22	.94326	305.8	14.9	.000210								
23	.94972	308.8	17.9	.000251								
24	.92478	315.9	148.4	.002084								
25	.91742	308.9	87.2	.001224								
26	.91967	304.5	63.4	.000891								
27	.91246	298.5	32.8	.000460								
28	.93049	305.2	37.4	.000526								
29	.93364	308.5	43.0	.000604								
30	.93650	307.9	47.1	.000661								
31	.94221	333.5	262.7	.003688								
32	.93124	318.9	154.0	.002162								
33	.93695	322.5	145.4	.002042								
34	.92763	310.3	76.3	.001072								
35	.92185	306.3	61.0	.000857								
36	.92110	303.6	41.8	.000586								
37	.95047	340.7	317.5	.004459								
38	.94761	330.0	198.5	.002788								
39	.94536	325.9	152.7	.002144								
40	.93515	313.0	84.1	.001181								
41	.93169	309.6	65.2	.000915								
42	.93214	307.2	44.8	.000629								
43	.96684	350.9	401.4	.005637								
44	.94957	325.5	158.6	.002227								
45	.94040	313.6	74.8	.001050								
46	.93740	310.8	61.0	.000857								
47	.93785	312.6	47.1	.000662								
48	.97428	350.7	348.2	.004890								
49	.95527	324.7	111.6	.001567								
50	.95490	325.8	132.4	.001859								
51	.95535	324.0	113.9	.001599								
52	.94401	319.7	125.5	.001762								
53	.94085	314.7	87.9	.001234								
54	.93950	311.8	65.5	.000920								
55	.94205	311.6	55.9	.000784								
56	.97465	346.5	293.9	.004127								
57	.94371	319.1	119.6	.001679								
58	.94190	313.1	67.9	.000953								
59	.94438	314.9	71.1	.000998								
60	.97540	347.8	279.0	.003918								
61	.94626	323.2	150.4	.002111								
62	.94431	317.8	103.9	.001459								
63	.94318	315.7	87.7	.001231								
64	.94378	317.3	99.4	.001396								
65	.94889	318.5	91.7	.001288								
66	.98194	353.3	332.5	.004670								
67	.97976	356.1	389.4	.005468								
68	.97931	354.9	377.6	.005303								
69	.95783	340.0	253.6	.003561								
70	.96909	344.5	295.7	.004152								
71	.97075	344.3	275.8	.003873								

[a] h measured in J/m^2-sec-$^{\circ}$K

TABLE V.- TABULATION OF HEAT-TRANSFER MEASUREMENTS ON MODEL WITH ROUGHNESS AT A NOMINAL REYNOLDS NUMBER BASED ON MODEL LENGTH OF 4.5 × 10[6]

(a) $\alpha = 0^{o}$

Thermocouple	$\beta = 0^{o}$; $T_w = 390^{o}$ K; $p_t = 462.1$ kN/m^2											
	$\frac{T_e}{T_t}$	T_w, ^{o}K	h (a)	N_{St}	$\frac{T_e}{T_t}$	T_w, ^{o}K	h (a)	N_{St}	$\frac{T_e}{T_t}$	T_w, ^{o}K	h (a)	N_{St}
1	.98285	374.5	648.2	.005495								
2	.98464	373.7	639.4	.005420								
3	.98471	372.0	600.8	.005093								
4	.98378	374.8	658.1	.005579								
5	.98198	370.6	577.2	.004893								
6	.98385	373.1	609.7	.005169								
7	.97603	368.7	590.9	.005009								
8	.95058	348.8	403.3	.003419								
9	.93752	338.2	250.6	.002125								
10	.94745	334.9	211.9	.001796								
11	.94588	331.9	180.4	.001529								
12	.94588	331.4	175.6	.001489								
13	.96820	365.8	523.8	.004441								
14	.93513	335.0	255.4	.002165								
15	.93715	323.4	103.1	.000874								
16	.94506	322.3	85.5	.000725								
17	.94446	321.5	90.6	.000768								
18	.94581	320.5	79.6	.000675								
19	.94760	319.4	71.5	.000606								
20	.94013	320.2	108.3	.000918								
21	.92573	309.6	63.9	.000541								
22	.92073	305.6	47.0	.000399								
23	.92163	305.0	39.8	.000338								
24	.95372	352.6	405.5	.003438								
25	.93864	335.5	275.0	.002331								
26	.94879	334.4	194.0	.001644								
27	.93536	324.7	152.8	.001296								
28	.92581	318.4	123.0	.001043								
29	.92200	316.2	112.5	.000954								
30	.91894	314.9	114.0	.000966								
31	.96976	365.7	535.3	.004538								
32	.94588	340.0	288.4	.002445								
33	.95387	343.5	263.7	.002235								
34	.94491	338.4	238.6	.002022								
35	.94327	335.8	218.0	.001848								
36	.94260	332.6	191.7	.001625								
37	.96290	360.2	488.8	.004144								
38	.95260	341.1	284.3	.002410								
39	.94842	343.4	286.3	.002427								
40	.94820	339.0	245.6	.002082								
41	.95014	337.9	232.8	.001974								
42	.95058	336.5	214.0	.001814								
43	.96409	358.2	462.1	.003918								
44	.94760	339.5	273.3	.002317								
45	.95208	336.2	194.1	.001645								
46	.95387	339.8	229.7	.001947								
47	.95118	338.2	231.3	.001961								
48	.96596	363.3	520.0	.004408								
49	.94954	335.5	208.3	.001766								
50	.94551	330.8	176.9	.001500								
51	.94394	329.5	163.5	.001386								
52	.94222	337.8	214.1	.001815								
53	.94894	336.7	177.6	.001506								
54	.95387	339.1	226.5	.001920								
55	.95230	339.3	242.3	.002054								
56	.96566	361.0	519.9	.004407								
57	.94372	338.2	213.6	.001811								
58	.95260	337.2	207.4	.001758								
59	.95223	339.1	238.7	.002024								
60	.96432	364.2	556.8	.004720								
61	.93909	340.7	211.1	.001790								
62	.94655	330.6	156.6	.001327								
63	.94999	336.2	214.6	.001819								
64	.94611	331.6	184.7	.001566								
65	.94476	330.3	168.8	.001431								
66	.95857	360.6	521.9	.004424								
67	.94730	350.4	394.8	.003347								
68	.94028	340.7	299.1	.002536								
69	.93596	328.4	169.7	.001439								
70	.94461	330.6	180.1	.001526								
71	.94461	330.2	166.9	.001415								

[a] h measured in J/m^2-sec-^{o}K

TABLE V.- TABULATION OF HEAT-TRANSFER MEASUREMENTS ON MODEL WITH ROUGHNESS AT A NOMINAL REYNOLDS NUMBER BASED ON MODEL LENGTH OF 4.5×10^6 - Concluded

(b) $\alpha = 20^o$

Thermo-couple	$\beta = 0^o$; $T_w = 392^o$ K; $p_t = 462.1$ kN/m^2											
	$\frac{T_e}{T_t}$	T_w, ^{o}K	h (a)	N_{St}	$\frac{T_e}{T_t}$	T_w, ^{o}K	h (a)	N_{St}	$\frac{T_e}{T_t}$	T_w, ^{o}K	h (a)	N_{St}
1	.96670	367.7	581.8	.004944								
2	.98499	377.7	707.7	.006014								
3	.98956	378.4	676.1	.005746								
4	.99056	375.2	561.7	.004773								
5	.99028	371.2	472.0	.004011								
6	.99114	371.1	449.6	.003821								
7	.98728	370.4	489.0	.004155								
8	.97512	364.8	483.2	.004106								
9	.96462	356.8	431.3	.003665								
10	.96930	362.8	484.2	.004115								
11	.96335	360.8	475.1	.004037								
12	.95154	358.1	526.7	.004476								
13	.94425	352.1	398.6	.003387								
14	.91675	319.6	162.5	.001381								
15	.91831	310.3	55.6	.000472								
16	.92165	312.8	61.8	.000526								
17	.91593	308.5	53.0	.000450								
18	.92076	308.6	44.9	.000382								
19	.92559	309.2	40.7	.000346								
20	.91868	12.6	62.1	.000527								
21	.91251	303.8	31.5	.000268								
22	.91913	304.9	27.5	.000234								
23	.92091	303.1	20.5	.000174								
24	.93444	340.6	309.9	.002633								
25	.92180	323.7	199.8	.001698								
26	.92834	323.3	145.9	.001240								
27	.91407	309.4	78.2	.000664								
28	.91214	305.0	42.8	.000363								
29	.91853	308.9	65.7	.000558								
30	.91496	306.6	61.3	.000521								
31	.95547	359.6	478.6	.004067								
32	.93578	337.2	272.5	.002315								
33	.94284	344.3	266.2	.002262								
34	.93087	328.7	161.0	.001368								
35	.92819	328.8	110.9	.000942								
36	.92255	315.3	85.5	.000727								
37	.95778	361.2	503.6	.004280								
38	.94752	344.6	315.8	.002684								
39	.94306	343.6	276.0	.002346								
40	.93905	329.2	160.3	.001363								
41	.93488	322.5	117.2	.000996								
42	.93176	319.0	91.6	.000779								
43	.96477	363.4	517.3	.004396								
44	.94544	339.2	260.0	.002209								
45	.94076	325.5	129.4	.001100								
46	.93741	321.3	106.2	.000902								
47	.93459	319.0	88.9	.000755								
48	.96997	364.6	481.7	.004094								
49	.94529	320.9	86.1	.000732								
50	.95101	333.7	170.5	.001449								
51	.94514	333.0	177.5	.001508								
52	.94098	331.9	204.1	.001734								
53	.93905	329.5	140.6	.001195								
54	.93689	321.5	114.1	.000969								
55	.93563	318.5	89.3	.000759								
56	.97155	362.8	457.2	.003885								
57	.94039	330.7	193.6	.001645								
58	.93734	322.7	123.9	.001053								
59	.93771	318.5	89.4	.000760								
60	.97141	363.6	439.2	.003732								
61	.93905	330.4	196.1	.001666								
62	.94618	330.2	156.4	.001329								
63	.95473	341.3	233.0	.001980								
64	.94856	336.2	208.4	.001771								
65	.94172	335.4	215.4	.001831								
66	.97083	365.5	481.3	.004090								
67	.96298	362.8	481.3	.004090								
68	.95793	357.9	437.8	.003720								
69	.94514	344.7	288.2	.002449								
70	.95391	350.5	368.0	.003128								
71	.94618	349.3	380.3	.003232								

[a] h measured in J/m^2-sec-^{o}K

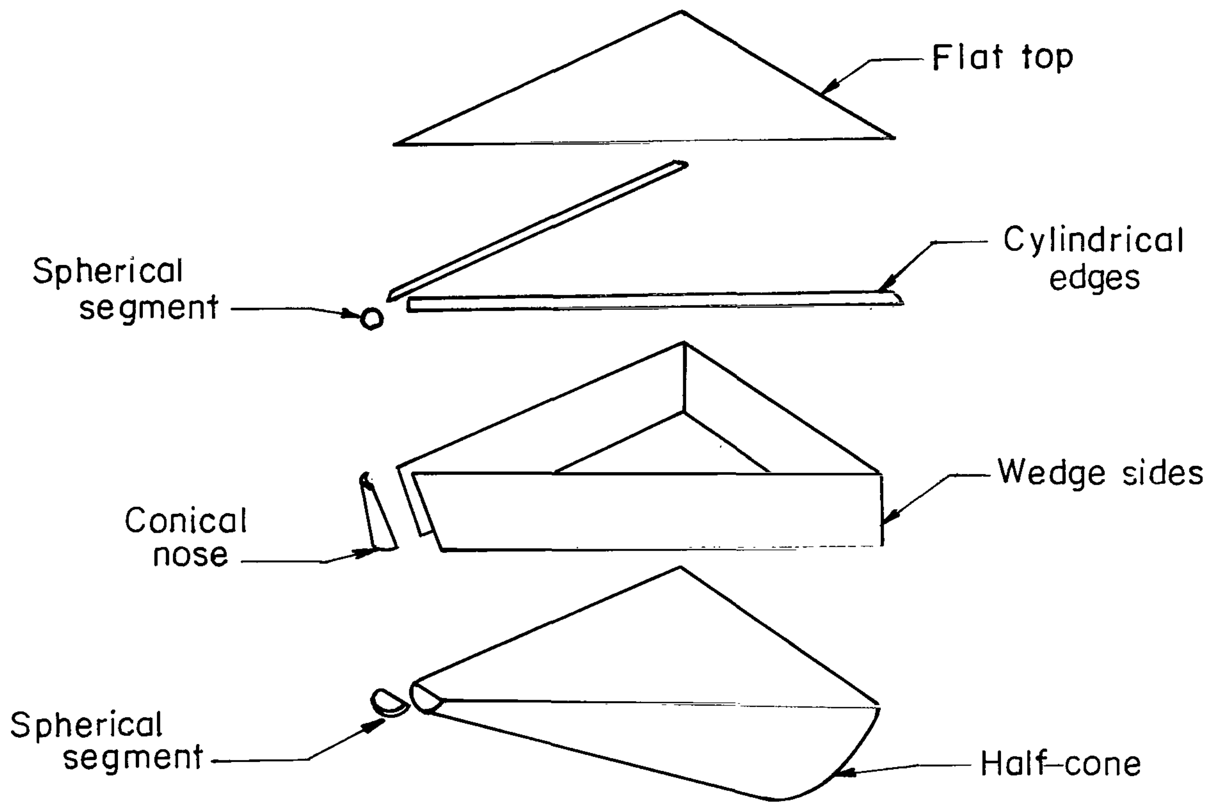
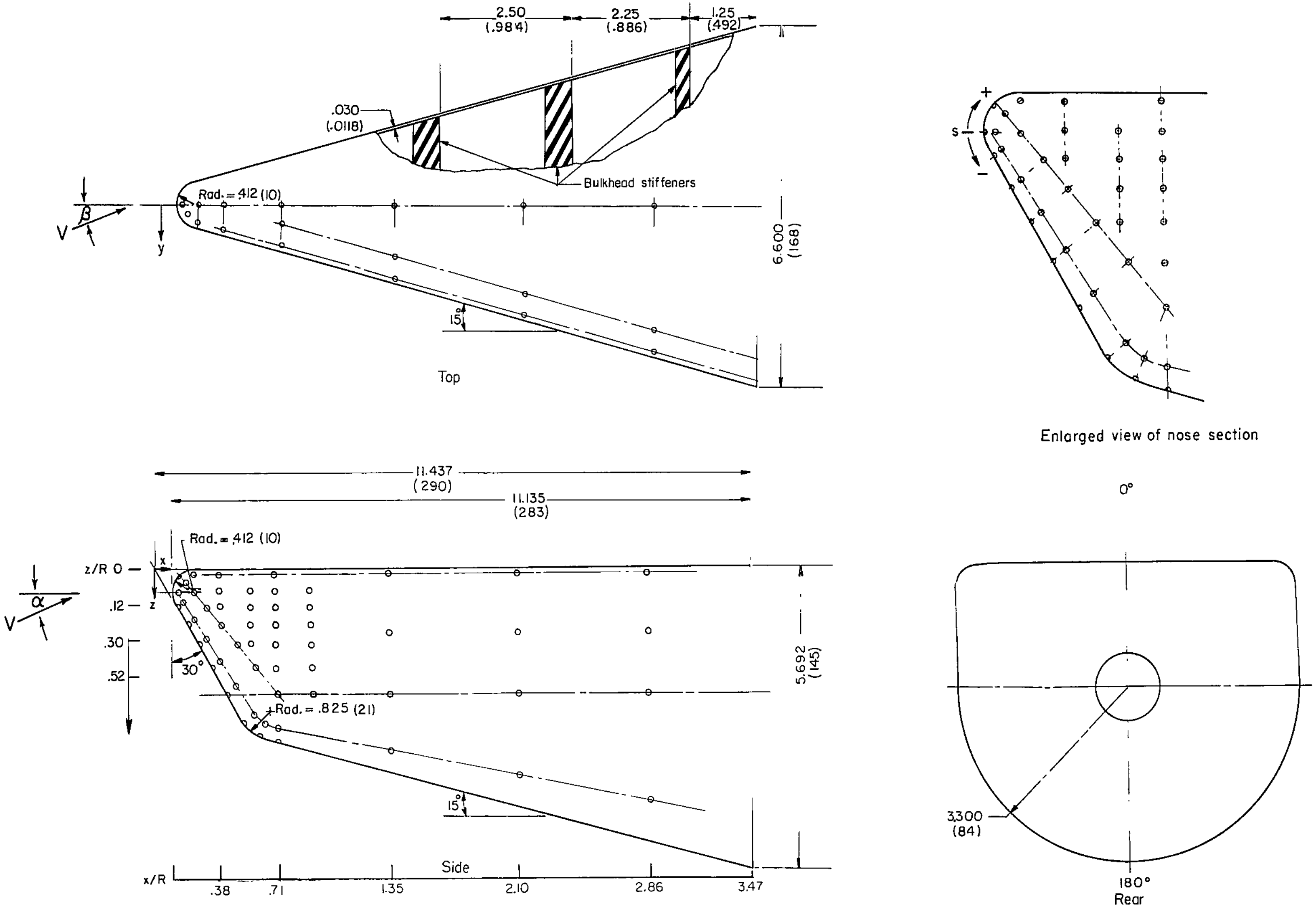
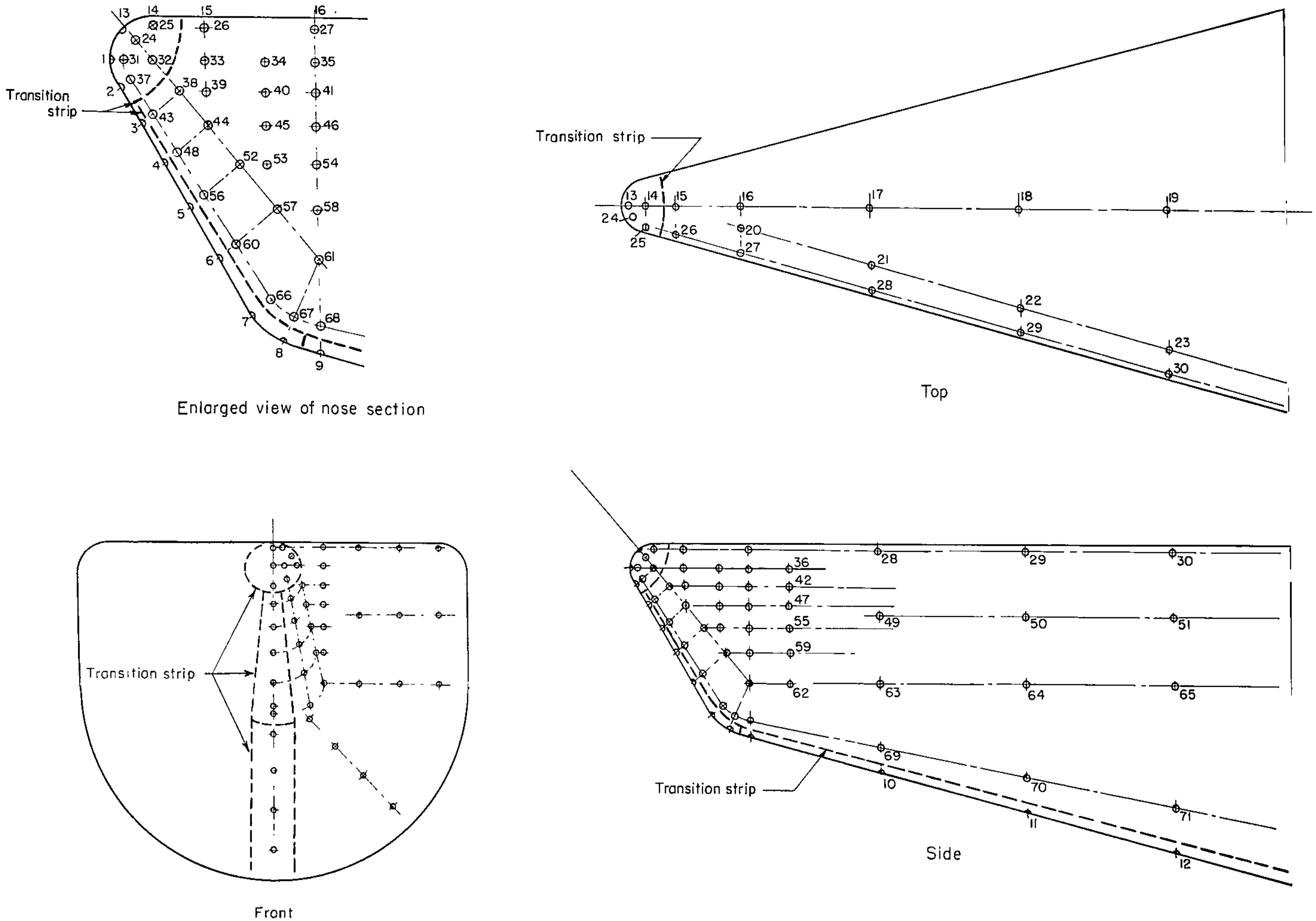


Figure 1.- Exploded view of model to show relationship of parts.



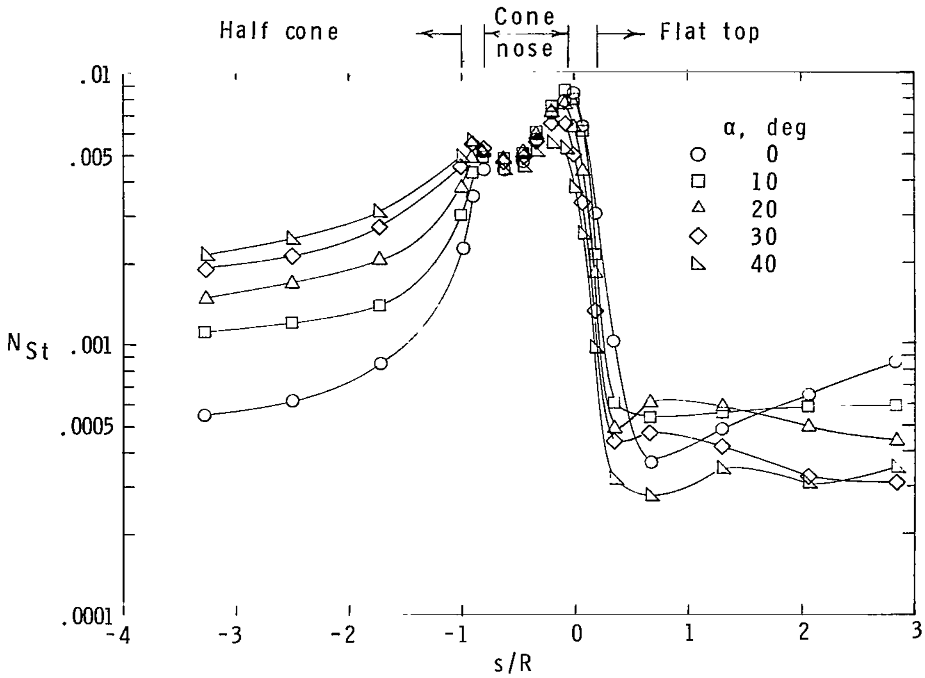
(a) Coordinate systems and model dimensions. (Dimensions are in inches (mm).)

Figure 2.- Model description.

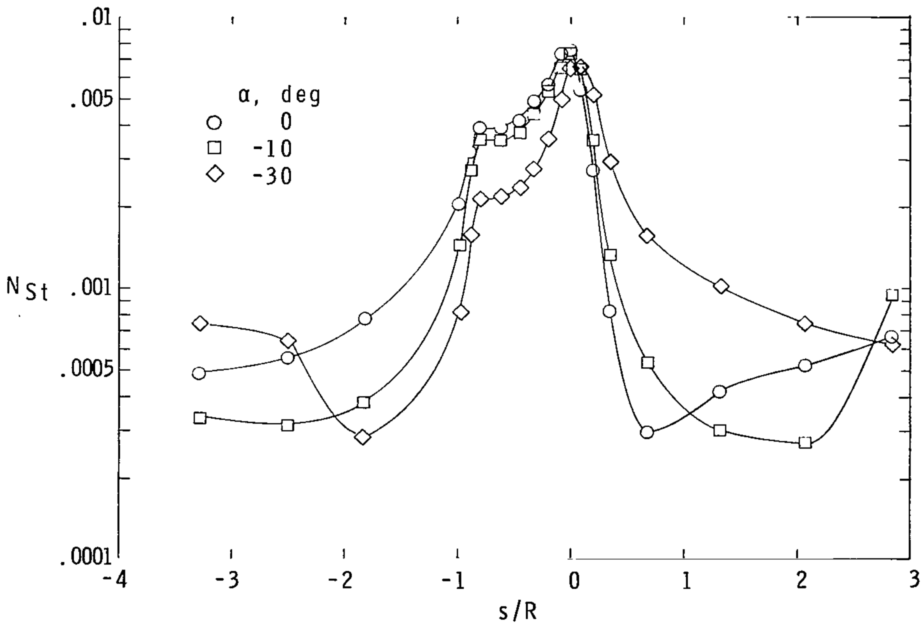


(b) Thermocouple identification.

Figure 2.- Concluded.

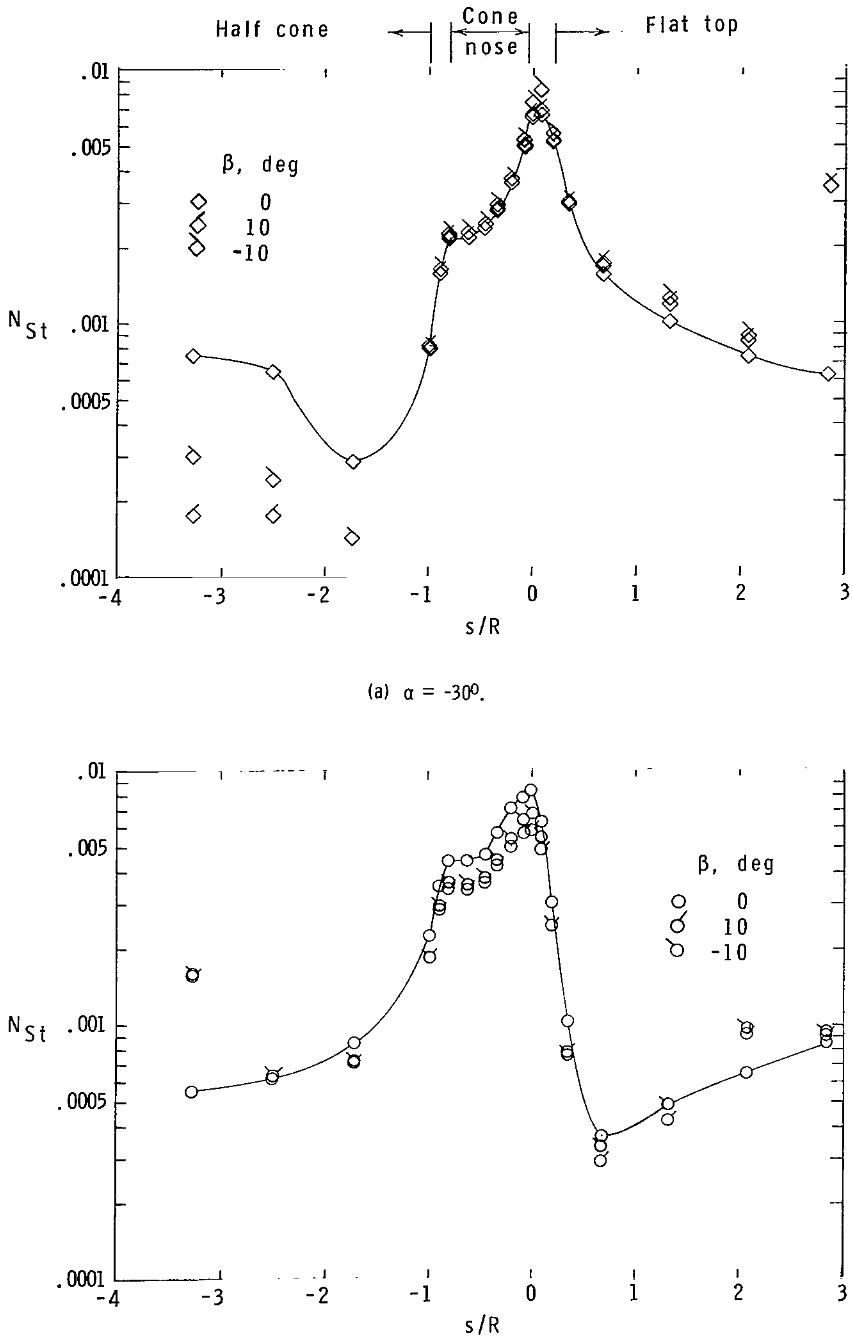


(a) Positive angle of attack.



(b) Negative angle of attack.

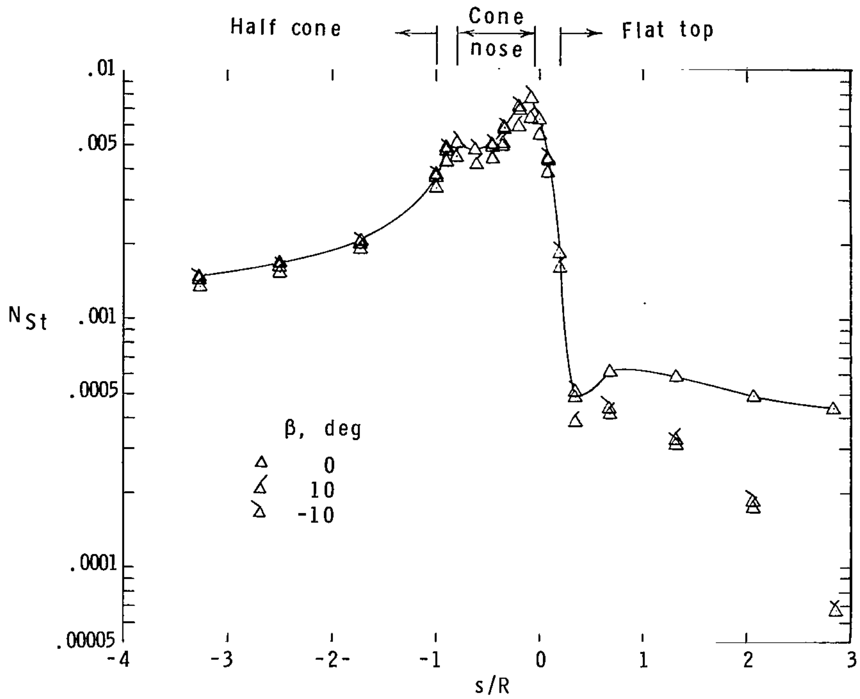
Figure 3.- Heating distributions in vertical plane of symmetry.



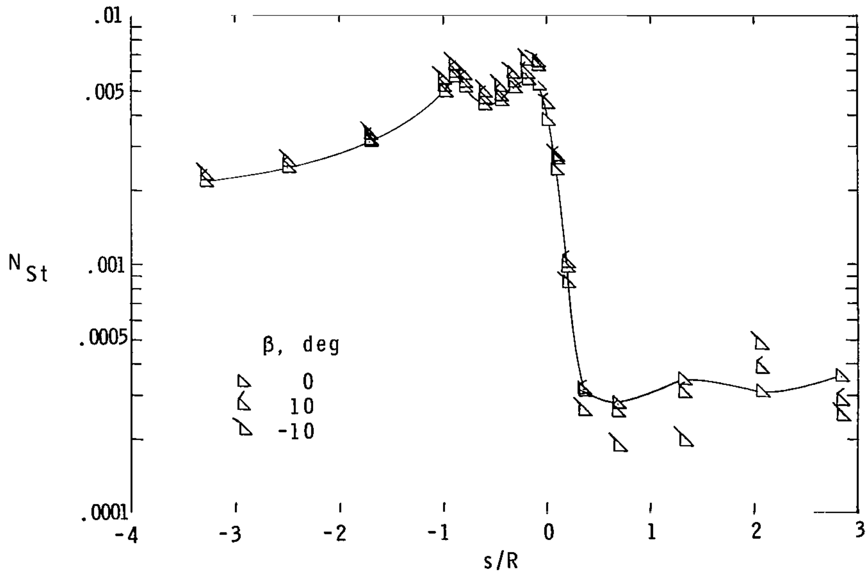
(a) α = -30°.

(b) α = 0°.

Figure 4.- Effect of sideslip on center-line heating distributions.

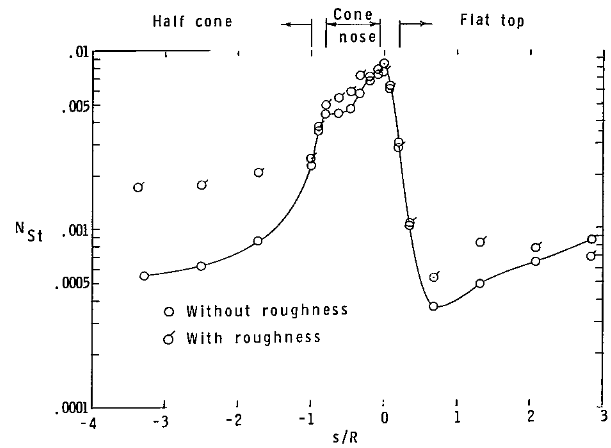


(c) $\alpha = 20^{\circ}$.

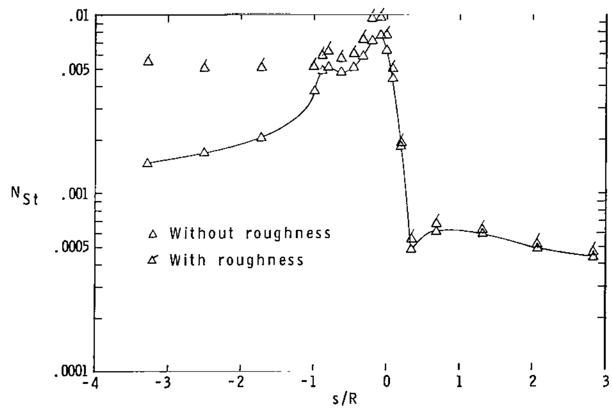


(d) $\alpha = 40^{\circ}$.

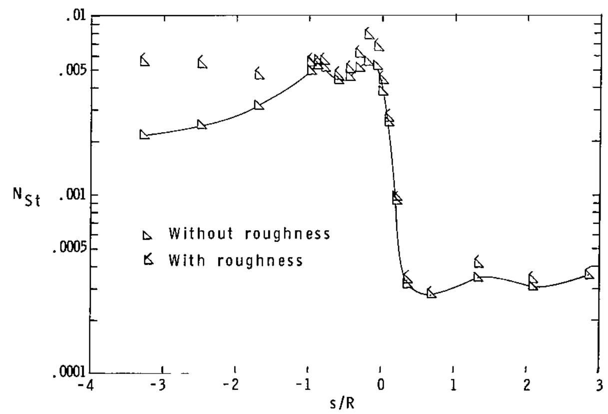
Figure 4.- Concluded.



(a) $\alpha = 0^{0}$.

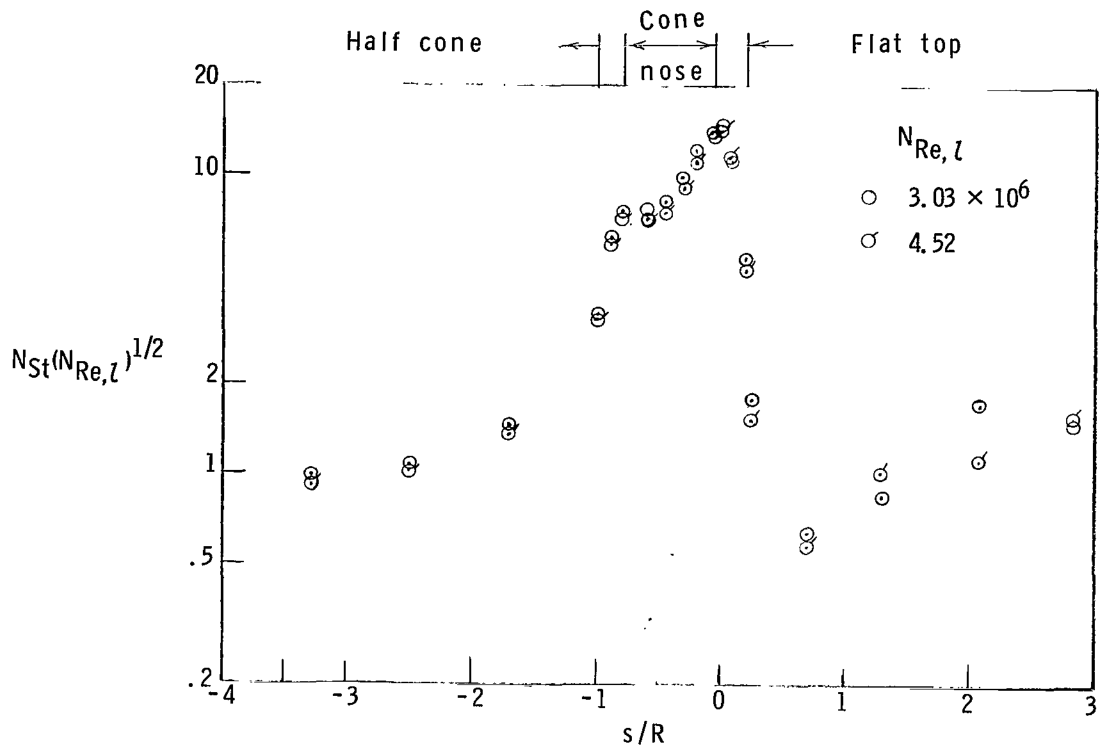


(b) $\alpha = 20^{0}$.

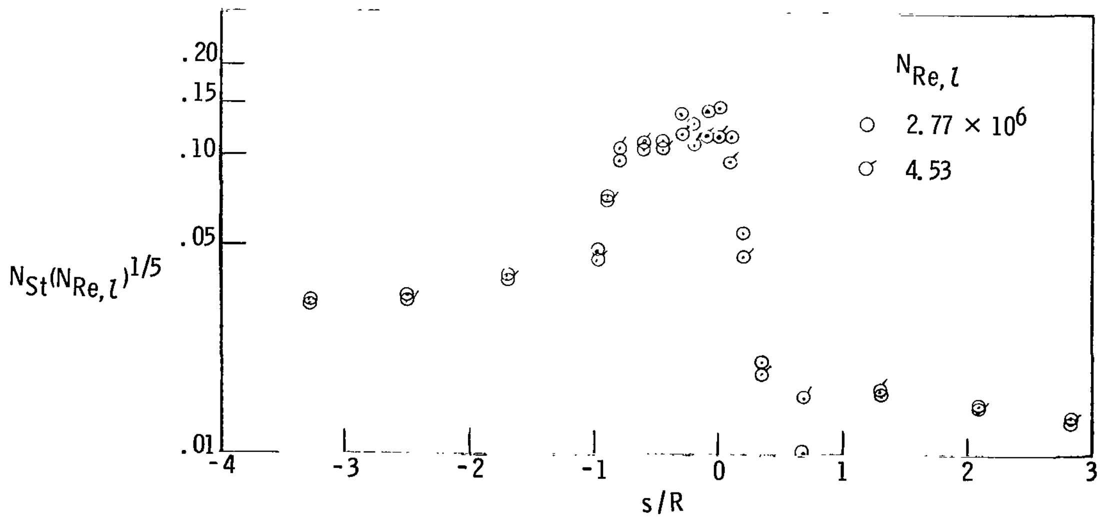


(c) $\alpha = 40^{0}$.

Figure 5.- Effect of roughness on center-line heating distributions.

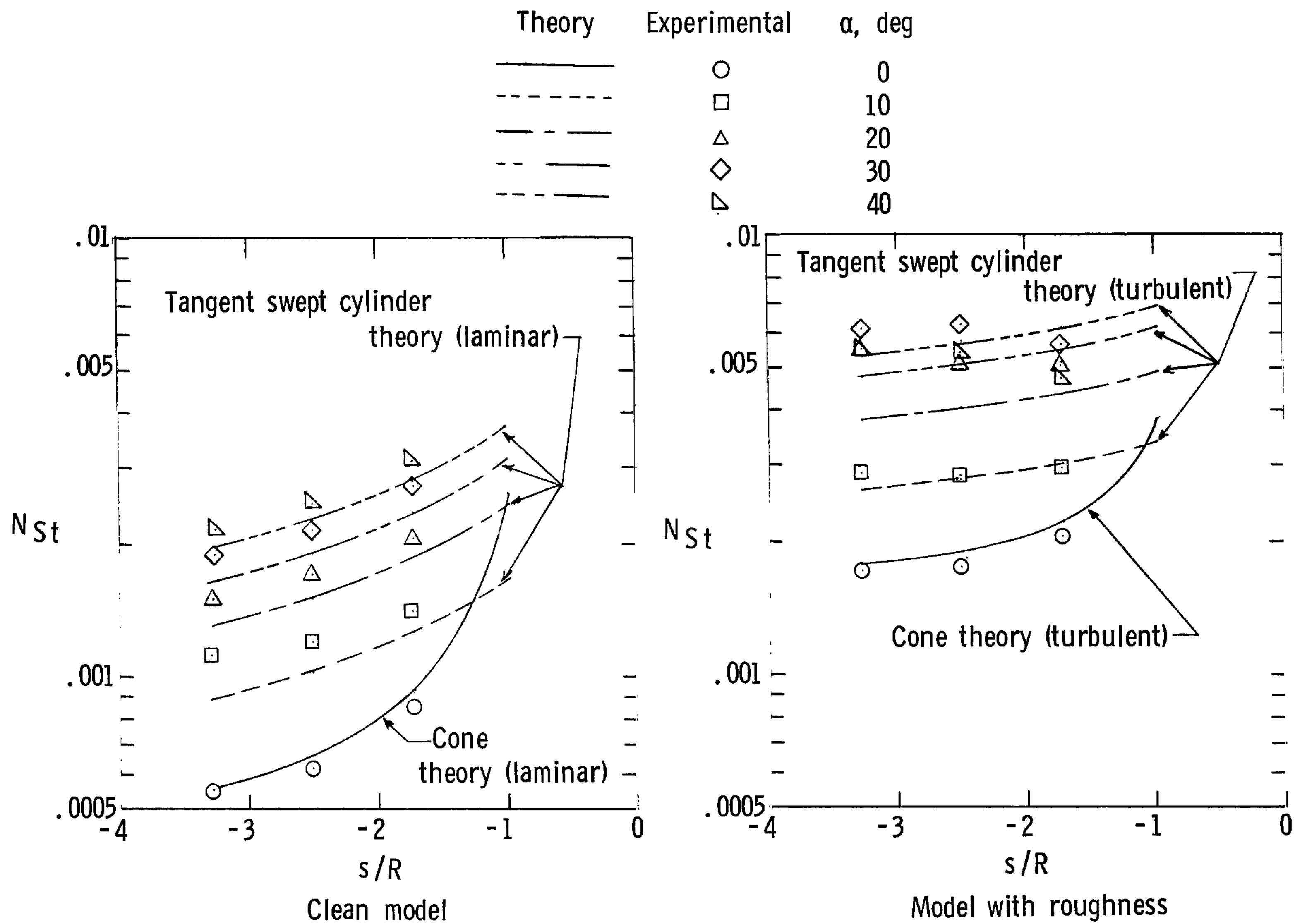


(a) Clean model.



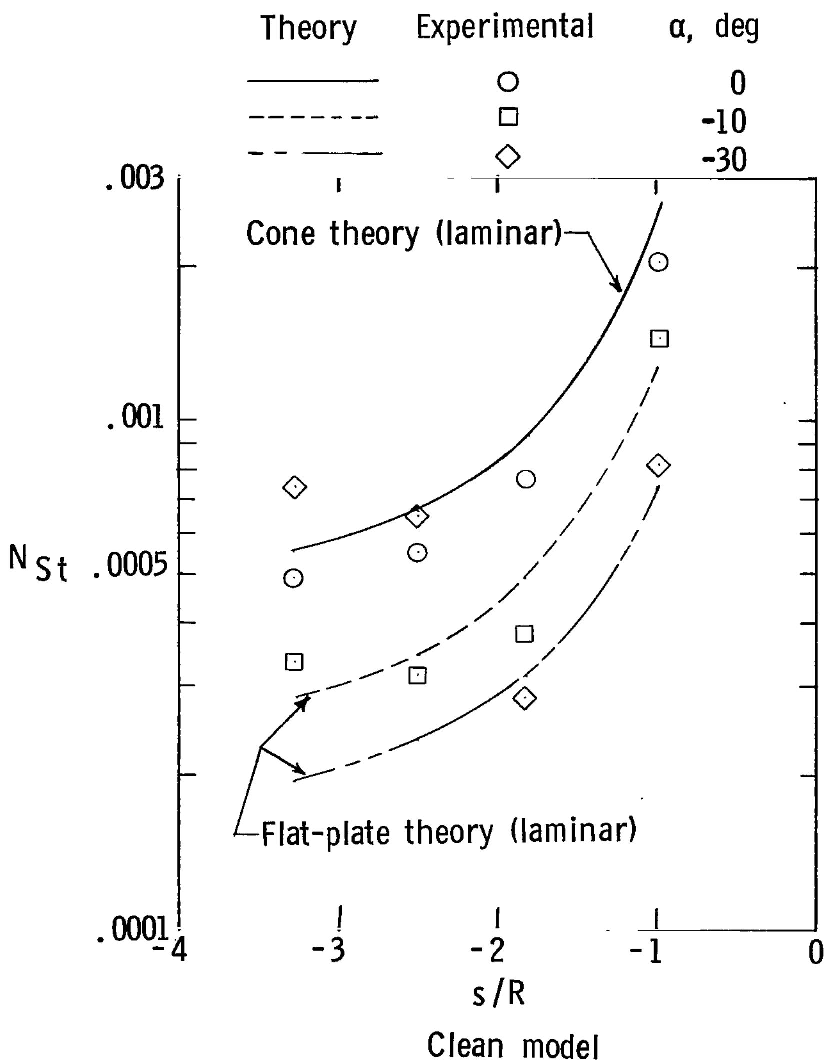
(b) Model with roughness.

Figure 6.- Effect of Reynolds number on center-line heating distributions.



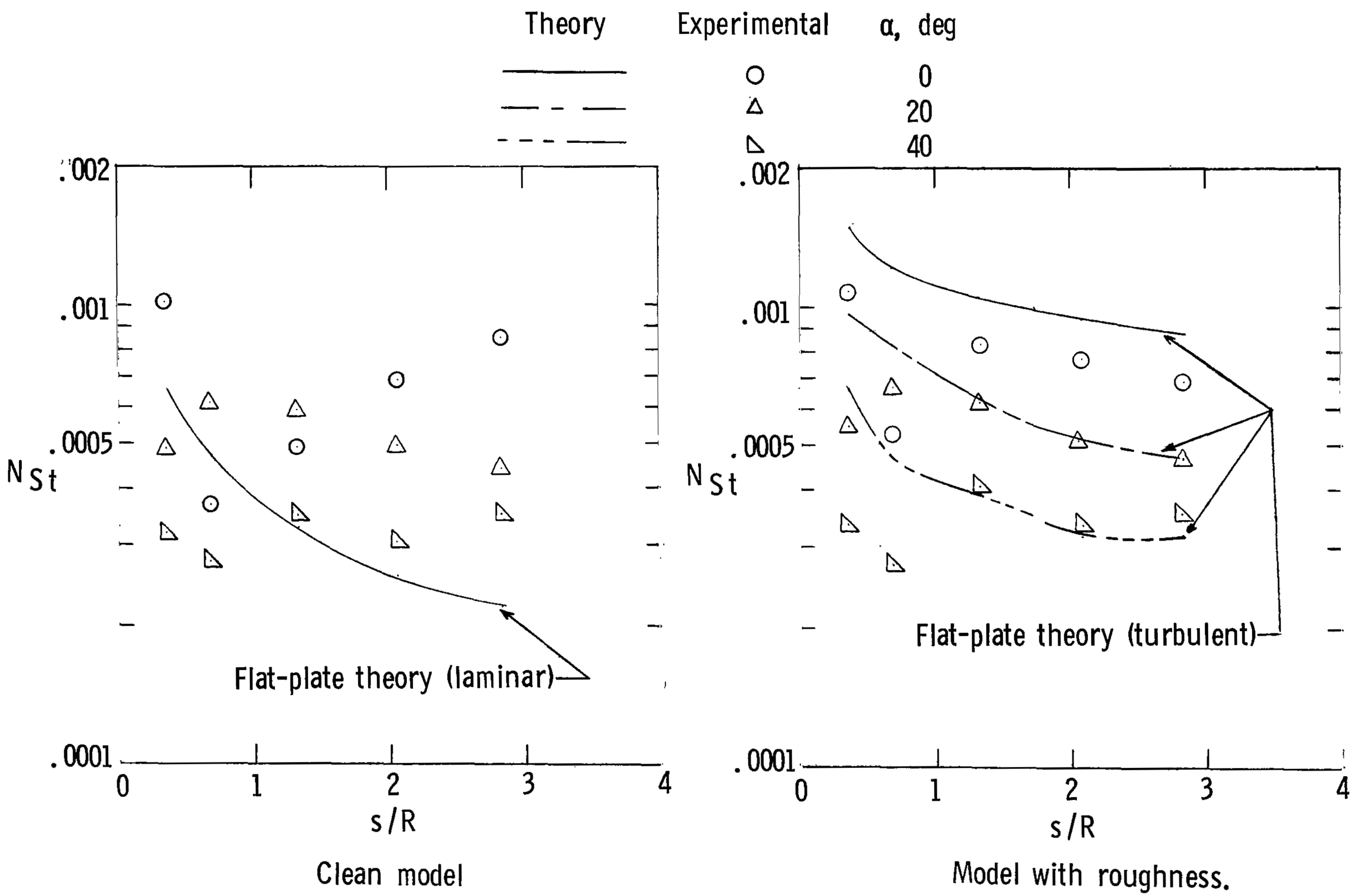
(a) Half-cone surface windward.

Figure 7.- Comparison with theory of measured heating distributions on half-cone surface.



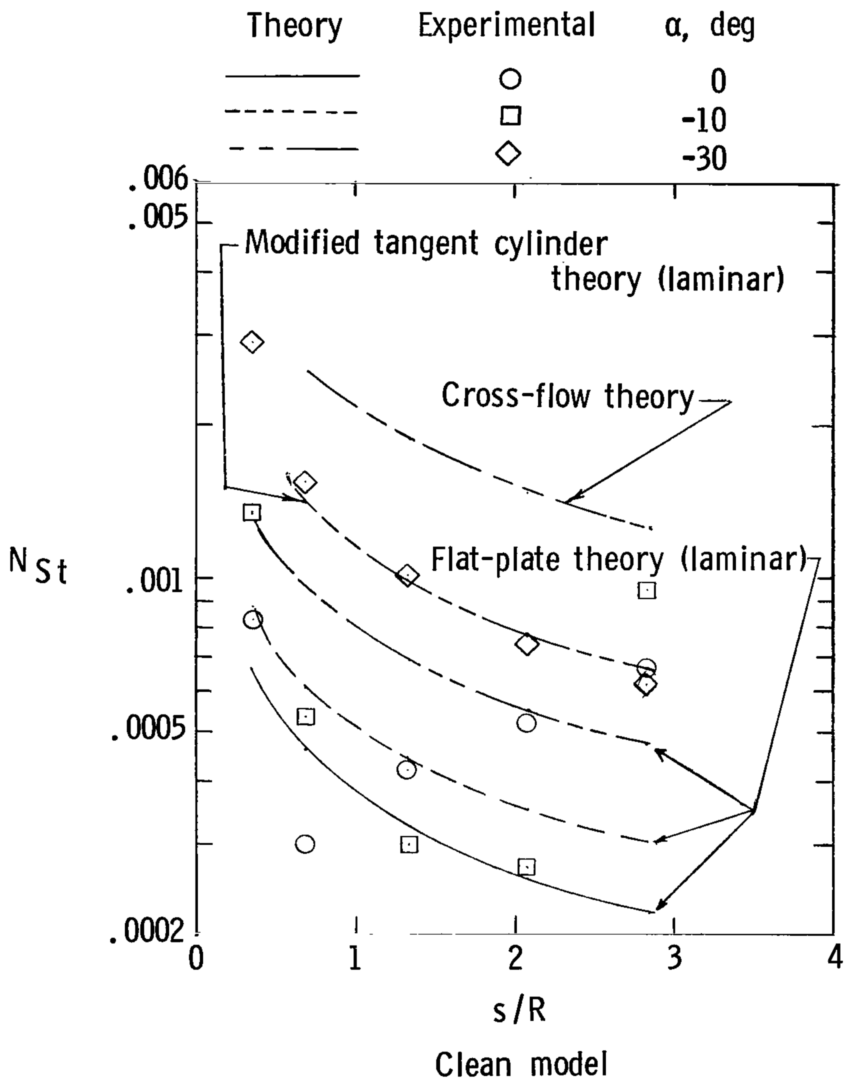
(b) Half-cone surface leeward.

Figure 7.- Concluded.



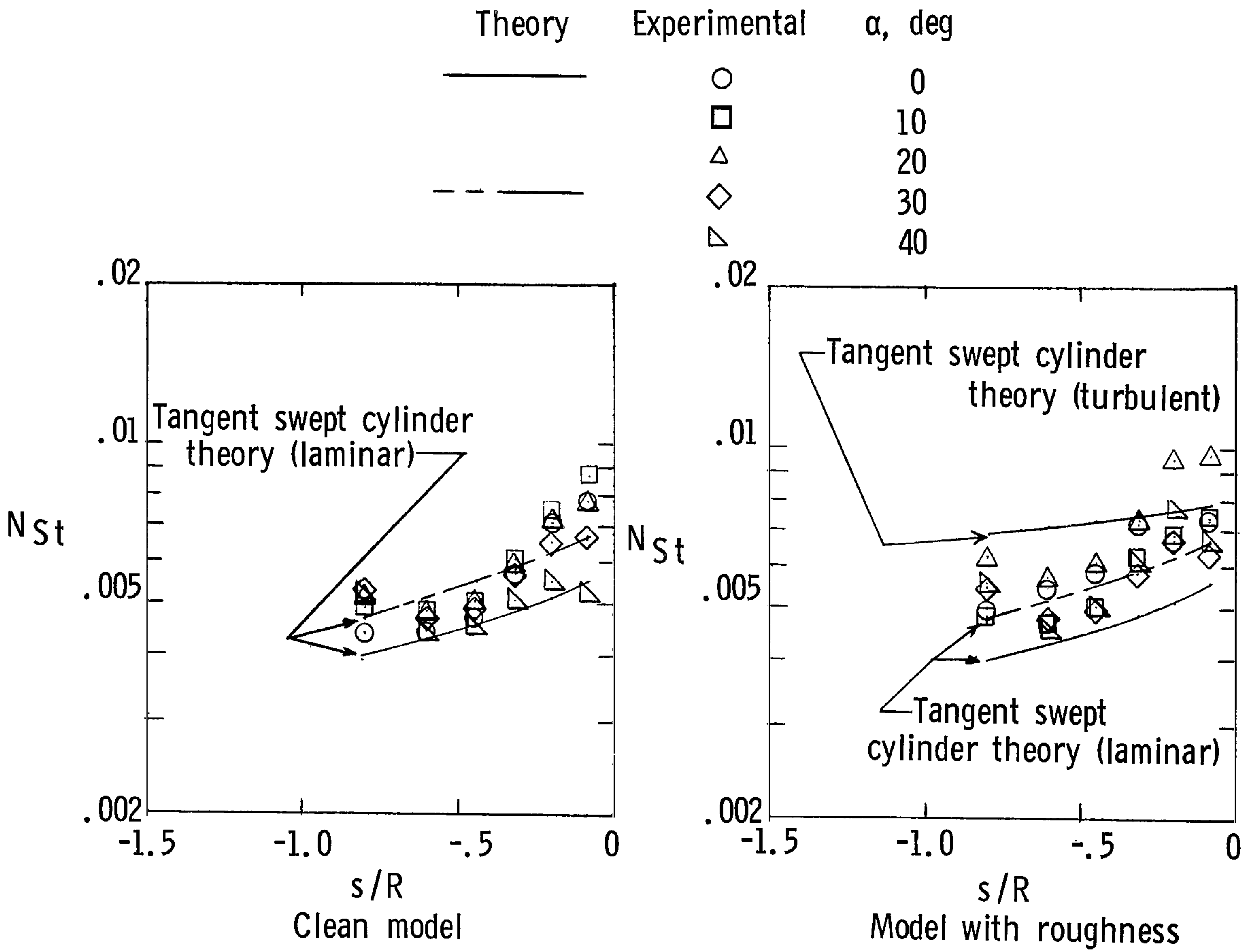
(a) Flat-top surface leeward.

Figure 8.- Comparison with theory of measured heating distributions on flat-top surface.



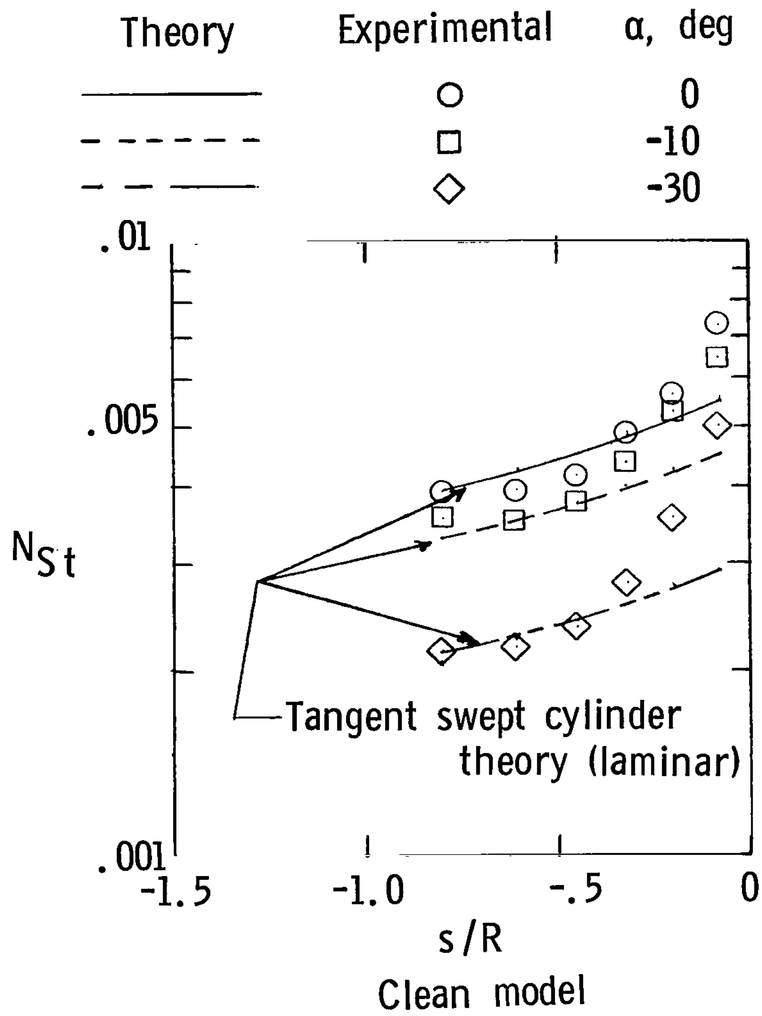
(b) Flat-top surface windward.

Figure 8.- Concluded.



(a) Positive angle of attack.

Figure 9.- Comparison with theory of heating distributions on center line of conical nose.



(b) Negative angle of attack.

Figure 9.- Concluded.

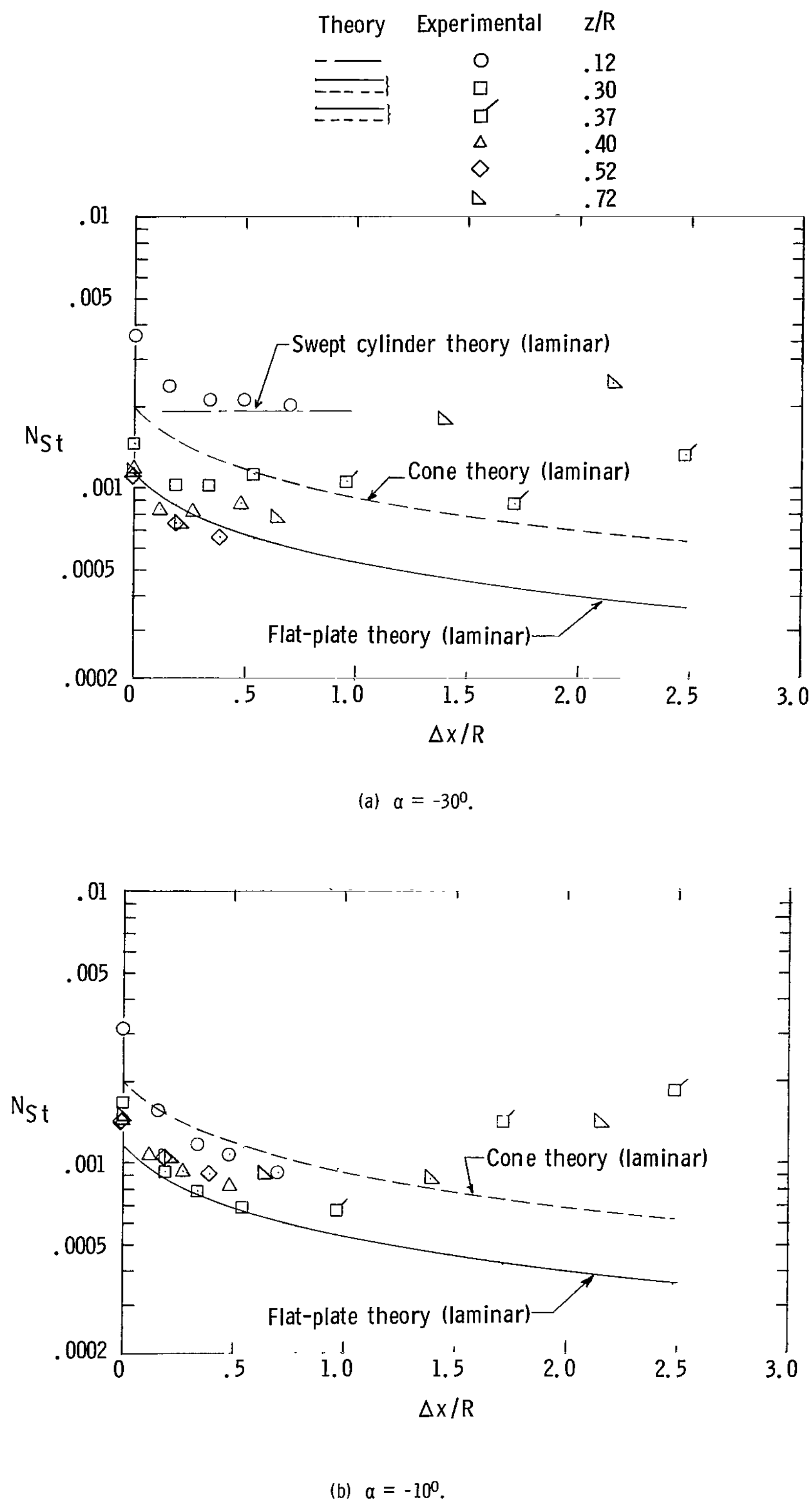
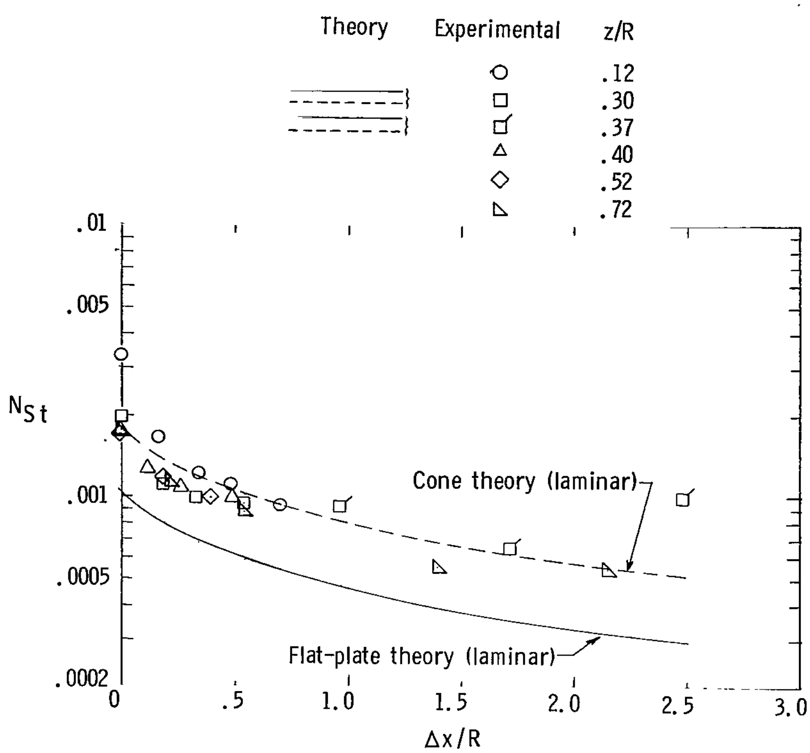
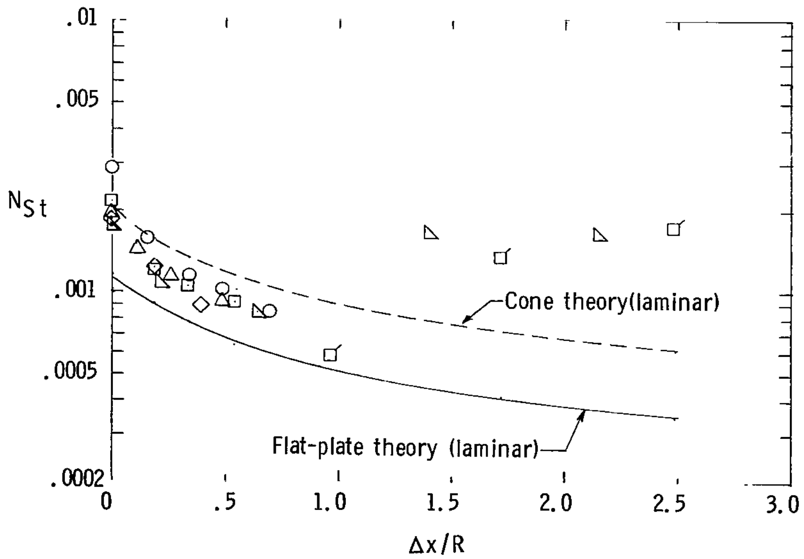


Figure 10.- Heating distributions on wedge side of clean model. $\beta = 0^{\circ}$.

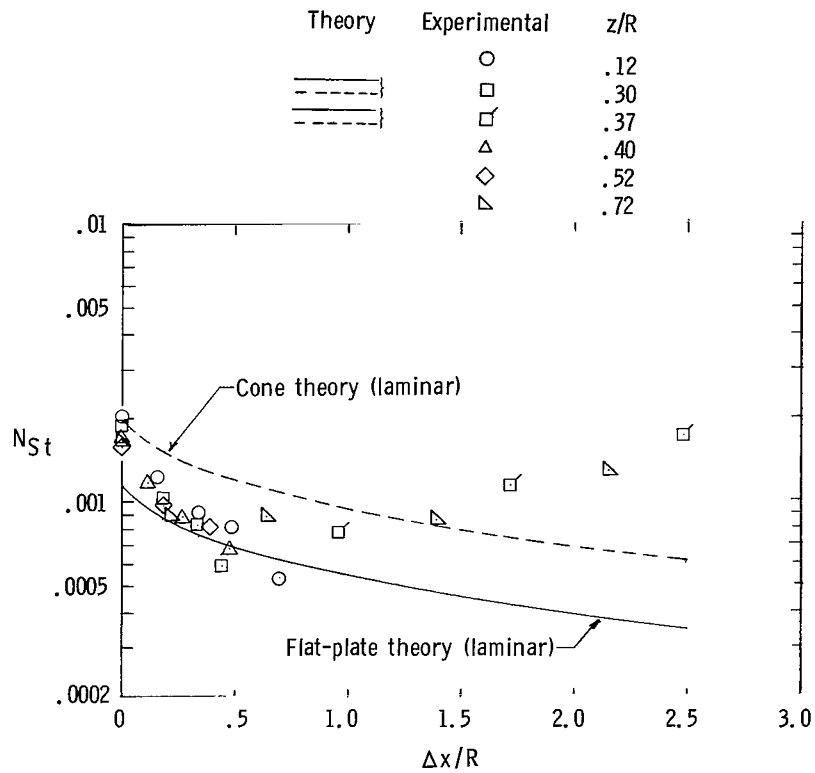


(c) α = 0°.



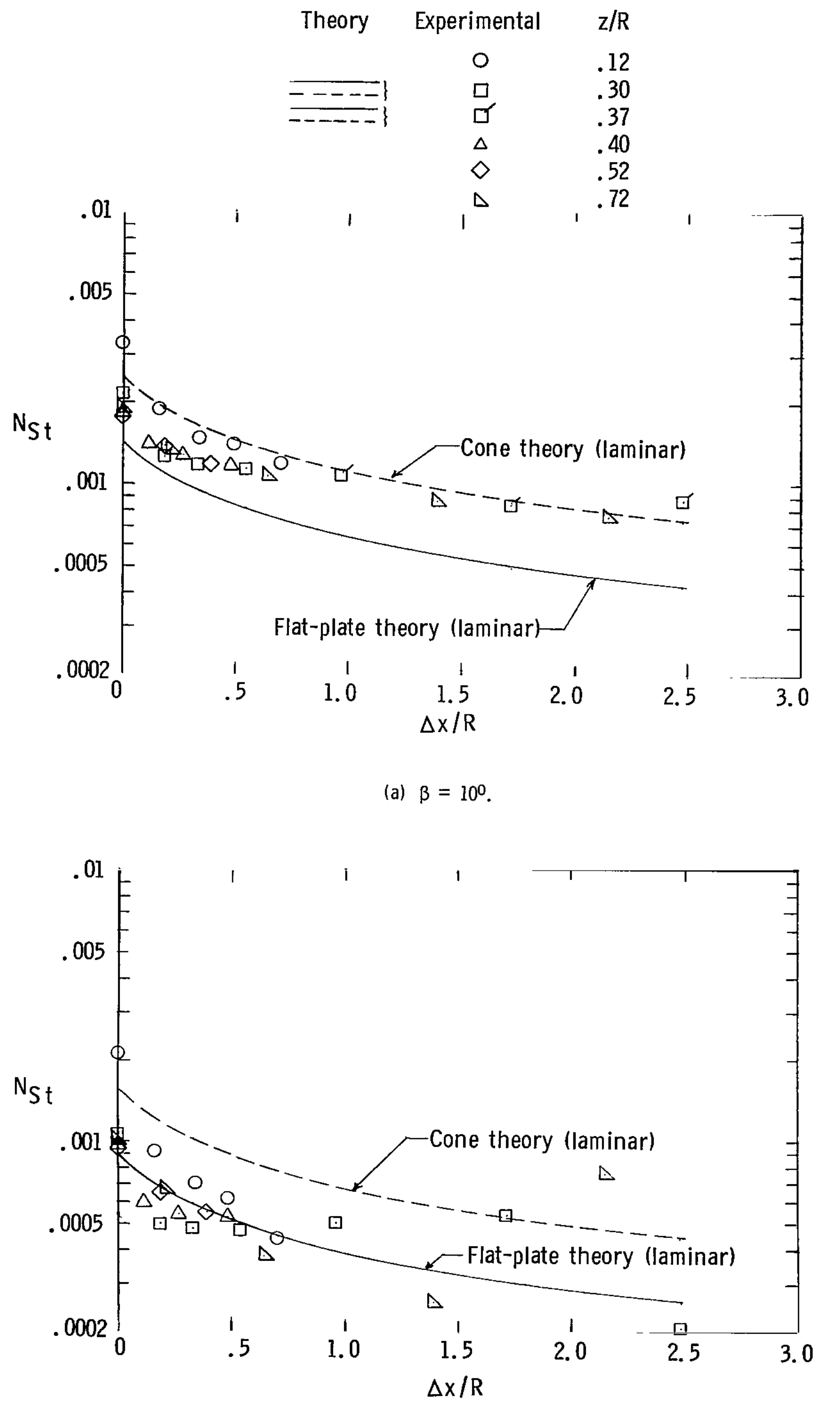
(d) α = 20°.

Figure 10.- Continued.



(e) $\alpha = 40^{\circ}$.

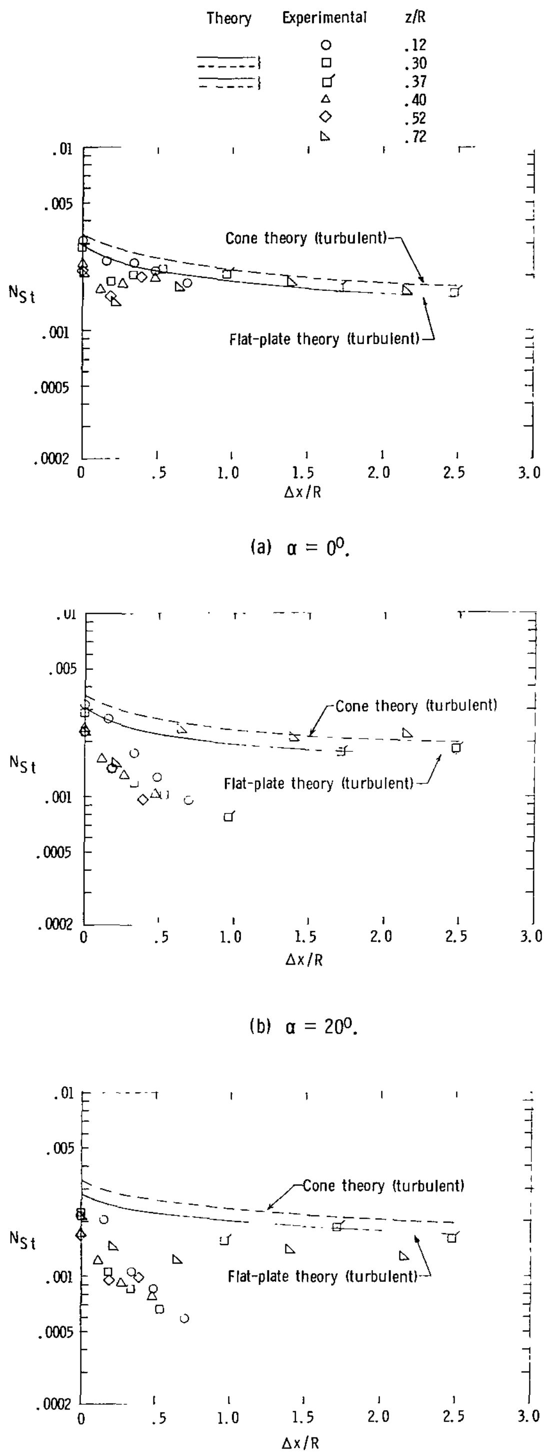
Figure 10.- Concluded.



(a) β = 10°.

(b) β = -10°.

Figure 11.- Heating distributions on wedge side of clean model at an angle of sideslip.



(a) α = 0°.

(b) α = 20°.

(c) α = 40°.

Figure 12.- Heating distributions on wedge side of model with roughness.

NASA-Langley, 1970 —— 33 L-6765

"The aeronautical and space activities of the United States shall be conducted so as to contribute . . . to the expansion of human knowledge of phenomena in the atmosphere and space. The Administration shall provide for the widest practicable and appropriate dissemination of information concerning its activities and the results thereof."

— NATIONAL AERONAUTICS AND SPACE ACT OF 1958

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